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# The Engineer.

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The Engineer

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PUBLIC NOTICES

Foreman of Works Required by the GOVERNMENT of NIGERIA for the PUBLIC WORKS DEPARTMENT, for two tours, each of not less than 12 and not more than 18 months, with possible extension. Salary £440 per annum, rising to £500 per annum by annual increments of £12. Outfit allowance of £45 on first appointment. Quarters free of rent and free passages. Liberal leave in England on full salary. Candidates, age 25 to 40, must have had experience in the sinking of concrete cylinders for bridge foundations and of bridge building.—Apply at once, by letter, mentioning this paper and stating age and full particulars of experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting M/10,765. 6132

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EVENING CLASSES suitable for Final B.Sc. (Eng.), A.M.I.C.E., A.M.I.M.E., &c., are held in the following subjects:—
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THEORY OF MACHINES AND MACHINE DESIGN.
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Students enrolled from SEPTEMBER 20th to 23rd. For further information apply to the PRINCIPAL.
DAY TECHNICAL COLLEGE.
FULL-TIME COURSES in MECHANICAL, CIVIL, and ELECTRICAL ENGINEERING for B.Sc. (Eng.) Degree, University of London or College Diploma. COMMENCE SEPTEMBER 27th. Entrance Examination commences September 20th.
Fee £18 per session. 6077

City of Cardiff Education Committee.
THE TECHNICAL COLLEGE.
PRINCIPAL: CHARLES COLES, B.Sc. (Lond.)
DEPARTMENT OF ENGINEERING.
HEAD OF DEPARTMENT: A. W. LOVERIDGE, B.Sc. (Eng.), A.R.C.Sc.
The following courses have been arranged for Engineering Students:—
A Three Years' Course in Mechanical and Marine Engineering, jointly with the University College of South Wales and Monmouthshire.
A Two Years' Course for Apprentices and others with facilities for practical experience in the summer term.
These courses are suitable for students preparing for degrees in engineering or for the examinations of the Engineering Societies.
Special Courses are also arranged for Marine Engineers preparing for the examinations of the Board of Trade.
Further information in regard to full-time and part-time Courses, fees, &c., may be obtained on application to the Principal.
JOHN J. JACKSON, B.A.,
Director of Education.
City Hall, Cardiff. 6159

ENGINEERING AND TECHNICAL OPTICS.
Northampton Polytechnic Institute,
ST. JOHN-STREET, LONDON, E.C.1.
ENGINEERING DAY COLLEGE.
Full-time Courses in the Theory and Practice of Civil, Mechanical, and Electrical Engineering. The Courses in Civil and Mechanical Engineering include specialisation in Automobile and AERONAUTICAL Engineering, and those in Electrical Engineering include specialisation in RADIO-TELEGRAPHY.
A SPECIAL ENTRANCE EXAMINATION is held at the end of September before the commencement of each session. The Courses include periods spent in commercial workshops and extend over four years. They also prepare for the Degree of B.Sc. in Engineering at the University of London. Fees £18 or £15 per annum.
THREE ENTRANCE SCHOLARSHIPS of the value of £62 each for the complete course will be offered for competition at the annual entrance examination in September.
OPTICAL ENGINEERING AND TECHNICAL OPTICS.
Full and Part-time Courses in this important Department of Applied Science are given in specially equipped laboratories and lecture rooms. The annual Entrance Examination is held at the end of September.
EVENING TECHNICAL COURSES
in all branches of Mechanical and Electrical Engineering commence on Monday, September 26th, 1921.
The laboratories, both mechanical and electrical, are well equipped with modern apparatus which, on the mechanical side, provides for specialisation in Automobile and Aeronautical Engineering, and, on the electrical side, for specialisation in Alternate and Continuous-current Work, in Radio-telegraphy and Telephony, and in Electrical Testing.
Particulars as to fees, dates, &c., and all information respecting the work of the Institute can be obtained at the Institute or on application to
R. MULLINEUX WALMSLEY, D.Sc.,
6138 Principal.

The Polytechnic, 309, Regent-STREET, W. 1.
A SPECIAL COURSE of LECTURES on "COST ACCOUNTS" will be delivered by Mr. E. G. LEGGE, A.C.W.A., on FRIDAYS, at 7.30 p.m., commencing 30th SEPTEMBER, 1921.
(Enrolments begin 14th September.)
Particulars from DIRECTOR OF EDUCATION. 6146

South Staffordshire Waterworks COMPANY.
REINFORCED CONCRETE SERVICE RESERVOIRS.
The Chairman and Directors invite TENDERS from Reinforced Concrete Specialists and Contractors for CONSTRUCTING TWO WATER-TIGHT REINFORCED CONCRETE COVERED SERVICE RESERVOIRS of 1 million gallons and 5 million gallons capacity respectively at Dudley.
Firms wishing to Tender may obtain particulars and plans from the undersigned.
The lowest or any Tender will not necessarily be accepted, and only Tenders from firms who have carried out similar work will be considered.
FRED. J. DIXON, M. Inst. C.E.,
Engineer-in-Chief.
26A, Paradise-street, Birmingham, September, 1921. 6160

LONDON COUNTY COUNCIL.
ENGINEERING
(CIVIL, ELECTRICAL, GAS, MARINE, MECHANICAL AND MOTOR CAR).
DAY AND EVENING CLASSES are held at the undermentioned institutions:—
BATTERSEA POLYTECHNIC, Battersea Park Road, S.W.11. (Mechanical and Electrical).
BOROUGH POLYTECHNIC, Borough Road, S.E.1. (Mechanical and Motor Car).
FINSBURY TECHNICAL COLLEGE, Leonard Street, City Road, E.C.2. (Day Classes only in Mechanical, Civil and Electrical Engineering).
EVENING ONLY:—
GOLDSMITH'S COLLEGE, New Cross, S.E.13. (Mechanical).
HACKNEY INSTITUTE, Dalston Lane, E.8. (Electrical, Mechanical and Motor Car).
NORTHAMPTON POLYTECHNIC, St. John Street, Clerkenwell, E.C.1. (Mechanical and Electrical).
PADDINGTON TECHNICAL INSTITUTE, Saltram Crescent, W.9. (Electrical and Mechanical).
REGENT STREET POLYTECHNIC, Regent Street, W.1. (Mechanical and Electrical).
SCHOOL OF ENGINEERING and NAVIGATION, High Street, Poplar, E.14. (Electrical, Marine and Mechanical).
WANDSWORTH TECHNICAL INSTITUTE, High St, Wandsworth, S.W.18. (Mechanical).
WESTMINSTER TECHNICAL INSTITUTE, Vincent Square, S.W.1. (Civil and Gas).
WOOLWICH POLYTECHNIC, William Street, Woolwich, S.E.18. (Mechanical and Electrical).
Full particulars as to fees, etc., may be obtained on application at the various institutions.
Evening Classes open 19th September, 1921.
JAMES BIRD,
6133 *Clerk of the London County Council.*

PUBLIC NOTICES

County Borough of Belfast.
ELECTRICITY DEPARTMENT.
The Corporation invite fresh TENDERS for the MANUFACTURE, DELIVERY and ERECTION, at the New Harbour Power Station, Belfast, of EXTRA HIGH-PRESSURE and LOW-PRESSURE SWITCHGEAR under "Section L."
The specification and other particulars already issued by Messrs. Preece, Cardew and Rider, 8, Queen Anne's-gate, Westminster, S.W.1, and by Mr. T. W. Bloxam, M.I.E.E., City Electrical Engineer, Belfast, shall be the basis of the Tenders now called for, which may take the form of a covering letter.
Tenders must be lodged in the Town Clerk's Office, City Hall, Belfast, not later than the 10th September, 1921.
The lowest or any Tender will not necessarily be accepted.
An official receipt must be obtained for every Tender delivered by hand. Tenders sent by post must be registered.
(Signed) R. MEYER,
Town Clerk.
7th September, 1921. 6157

Siamese State Railways.
TENDERS are INVITED for the SUPPLY of SUPERSTRUCTURES of STEEL RAILWAY BRIDGES.
Specifications and drawings may be obtained against payment of 10s. from Messrs. C. F. Sandberg, 40, Grosvenor-gardens, London, S.W. 1.
Sealed Tenders, with the inscription "Tender for Railway Bridges, 2464," must be forwarded to the undersigned, at whose offices in Bangkok, Siam, they will be received up to 2 p.m. on the 31st day of December, 1921.
Right is reserved to reject any or all Tenders and to accept part of any Tender which is deemed to be most favourable to the interests of the Siamese State Railways.
PURACHATRA,
Commissioner General of Siamese State Railways.
Bankok, 1921. 6134

PUBLIC NOTICES

Bombay, Baroda, and Central INDIA RAILWAY COMPANY.
The Directors are prepared to receive up to Noon on Friday, 7th October, TENDERS for the SUPPLY of:—
CLASS A.
1. DOG SPIKES.
2. STEEL MATERIAL.
CLASS B.
1. FENCING MATERIALS.
2. STEEL FISH BOLTS, NUTS and WASHERS.
3. WROUGHT IRON.
4. GALVANISED STEEL or IRONWORK.
CLASS C.
1. PIG IRON.
Tenders must be made on forms, copies of which, with specification, can be obtained at these offices on payment as follows:—
For Class A, 20s. each; for Class B, 10s. each; and for Class C, 5s. each (which will not be returned).
The Directors do not bind themselves to accept the lowest or any Tender.
S. G. S. YOUNG,
Secretary.
Offices: The White Mansion, 91, Petty France, Westminster, S.W. 1.
12th September, 1921. 6144

RESIDENT ENGINEER.
The Committee of Visitors of the Worcester County and City Mental Hospital, Powick, near Worcester, invite APPLICATIONS for the POST of RESIDENT ENGINEER at the Hospital. Salary £225 per annum, with partly furnished house, coal, gas and garden produce. The appointment is subject to the provisions of the Asylums Officers' Superannuation Act, 1909.
Form of application and any other particulars of the office may be obtained from the Medical Superintendent. Applications, endorsed "Resident Engineer," together with copies of not more than three recent testimonials, to be received not later than first post on Thursday, 22nd September 1921, by the MEDICAL SUPERINTENDENT, Powick Mental Hospital, Worcester. P4019

PUBLIC NOTICES

The West Pier Company Require
TENDERS for CONCRETING under water and STEEL WORK.—Apply, the Engineer, M. NOEL RIDLEY, Standard House, Cardigan-road, Leeds, or to the Secretary, THE WEST PIER COMPANY, Brighton. 6162

Yorkshire (W.R.) Electric Tramways.
APPLICATIONS are INVITED for POST of ELECTRICAL ENGINEER. Only persons of energy and ability and with thorough practical and theoretical training and experience need apply.
A statement of duties and application schedule will be forwarded on request.
H. ENGLAND,
General Manager.
Belle Isle, Wakefield, 6th September, 1921. 6105

SITUATIONS OPEN

WANTED, ASSISTANT in Works Manager's Department. Applicants must be under 30 years of age and previous experience in Works Training essential.—Apply in writing, stating age, qualifications, and salary required, to EDWARD ELWELL, Limited, The Forge, Wednesbury. 6139 A

A CAPABLE SELLING AGENT REQUIRED by a leading Firm of Lubricating Oil Manufacturers. Excellent opportunity for right man.—Write, Box 712, Sell's Advertising Offices, Fleet-street, E.C. 4. 6171 A

ASSISTANT MANAGER WANTED for Small Steel Construction Shop. Capable of taking complete control of outside erection. State experience, age, and salary required.—Address, 6168, The Engineer Office. 6168 A

CHIEF ENGINEER REQUIRED by a Firm operating extensive collieries, iron and steel works, &c. The duties embrace the design and execution of all new works, the maintenance and modification of existing plant, and the supervision of all departmental engineers, drawing-office, and the central engineering workshops, &c.
The man appointed will be expected to see that all machinery throughout the company's operations is run at the maximum efficiency.
The position demands initiative, energy, and an exceptionally high degree of scientific and technical knowledge and a wide practical experience.
Address, stating age, full particulars of qualifications, and salary required, 6179, The Engineer Office. 6179 A

ELECTRO-CHEMICAL WORKS MANAGER REQUIRED for South Africa; must have necessary technical qualifications and be accustomed to dealing with principals of large concerns.—Address, 6169, The Engineer Office. 6169 A

EFFICIENCY ENGINEER.—WANTED by a Power Company in the North Midlands, an EFFICIENCY ENGINEER, whose whole time will be devoted to combustion, steam consumption and kindred economic investigations. The successful candidate must have a thorough scientific training, and at the same time a thorough practical knowledge of combustion, steam raising and consumption. Applications in the first instance to be by letter only, stating age, qualifications, salary required, and when free.—Address, 6151, The Engineer Office. 6151 A

HIGHLY QUALIFIED OIL CHEMIST WANTED to do research work and control staff of assistants and to conduct experiments in low temperature carbonisation.—Write, stating full qualifications, salary required, to Box 717, Sell's Advertising Offices, Fleet-street, E.C. 4. 6170 A

MESSRS. NORTONS (Tividale), Ltd., Hecla Works, Tipton, Screening Plant Specialists, Structural Engineers and Ironfounders, are prepared to receive APPLICATIONS from gentlemen of influence with collieries, architects, and gasworks, &c., for their AGENCIES in the districts of (1) Yorkshire, (2) Notts and district, (3) Northumberland and Durham. Mainly commission basis. References essential. 6176 A

REQUIRED, Capable ENGINEER'S REPRESENTATIVE for Semi-Diesel and Marine Sales Department. Must have full knowledge of export trade and buyers.—Write, Box "A. E." c/o C. D. Clayton, Ltd., 126, Long-acre, W.C. 2. 5707 A

WORKS MANAGER WANTED for Hot and Cold Steel Rolling Mills in Staffordshire, to Take Charge of Works producing Hot Rolled Sheets, Strips, Flats and Special Sections, and Cold-rolled Strips and Sheets. Applicants must have the necessary experience in the trade and be capable of controlling the labour and producing the output on the most economical basis consistent with quality.—Address, stating experience, age, giving references in confidence, stating when at liberty and salary required, 6136, The Engineer Office. 6136 A

WORKS MANAGER WANTED for Large Marine Engine Works, reciprocating and Diesel engines and turbines; must have had previous experience of organising similar work. Applicants should forward full particulars, age, experience, &c.—Address, 6177, The Engineer Office. 6177 A

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ARCHITECTURAL DRAUGHTSMAN (Ju ior) RE-QUIRED with previous drawing-office experience, knowledge of Building Construction and Surveying and Levelling.
Preference given to ex-Service men.
Write, stating age, experience, salary required, and enclosing recent testimonials, together with evidence of military service, if any, to the OFFICER IN CHARGE OF WORKS, Naval Training Establishment, Shotley, near Ipswich. 6114 A

DRAUGHTSMAN and ESTIMATOR REQUIRED to Take Charge of Drawing-office, by Manufacturers of Conveying and Elevating Machinery, Coal handling Plants, Structural Work, &c. Works near London.—Address, stating full particulars, P4031, The Engineer Office. P4031 A

DRAUGHTSMAN, With Experience in Aerial Ropeways and/or Crane Work.—Please state experience and salary required to Chief Draughtsman, JOHN M. HENDERSON and CO., Aberdeen. 6174 A

FITTER-DRIVER REQUIRED, Gold Mine, West Africa, to Take Charge Power Station Machinery. Sound mechanical, steam and three-phase electrical experience essential. Wage 20s. per shift.—Address, stating age, experience, with copies testimonials, 6178, The Engineer Office. 6178 A

DIE CASTINGS.—First-class MAN WANTED, thoroughly familiar with all latest processes in manufacture of Aluminium Die Castings. Able to initiate, design dies, and supervise whole of manufacture.—Address, with full details as to experience, 6149, The Engineer Office. 6149 A

## SITUATIONS WANTED

A.A.A.—GENTLEMAN (33), Good Address, 6ft., DESIRES any OPENING; electrical and mechanical training; experience covering central station, marine, coal and metalliferous mining plants, steam, Diesel, hot-bulb, petrol and suction gas engines; war service, 5 years commissioned engineer officer, Royal Navy; Spanish and French; open to immediate engagement, home or abroad; min. salary at home £300.—Address, P3982, The Engineer Office. P3982 B

ADVERTISER, Who Has Kept His Works (Engineering and foundry) going all through slump, SEEKS fresh POSITION. At present general manager controlling engineering works, but outside influences handicap progress. Thoroughly trained, especially in administration. Excellent initiative and organising ability. Would consider the reorganisation of a business and payment by results.—Address, 6173, The Engineer Office. 6173 B

A.M.I. MECH. E., A.M.I.E.E. (Both by Exam.), DESIRES POST as ENGINEER-IN-CHARGE of power station or similar position. Excellent refs. from firms of repute. Young and energetic. At liberty in November.—Address, P4047, The Engineer Office. P4047 B

ASSIST. MANAGER, FOREMAN, INSP., or Any similar POST WANTED; 14 yrs. mech., elect., motor, loco. engineering; examined loco. and Lancs. boilers; held positions loco. shed supt., head foreman; war service 4 years, Lieut., H.L.I. and R.E. D.O. experience, certifs. in higher maths., mechanics and heat engines, &c., A.M.I.E.E. Inst. (30); good refs.; mod. salary.—Address, P4015, The Engineer Office. P4015 B

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CHIEF WORKS ENGINEER (Mechanical and electrical), with twenty years' experience amongst large works plants, DESIRES responsible APPOINTMENT. Salary about £650 p.a.—Write, "C. H. O.," c/o J. W. Vickers and Co., Ltd., 5, Nicholas-lane, London, E.C. 6111 B

CIVIL ENGINEER, A.M.I.C.E., DESIRES POSITION in Civil Engineer's or Contractor's Office. Seven years' experience as assistant engineer on public works covering factory lay-out, foundations and construction. Engagement at home, preferably in London. Present contract finishing.—Address, P4009, The Engineer Office. P4009 B

CIVIL ENGINEER, B.Sc. (Lond.), G.I. Mech. E., just completed university training, SEEKS OPENING for practical experience. Capable surveyor, good experience D.O. Living wage only first year.—Address, P4045, The Engineer Office. P4045 B

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CIVIL ENGINEER, 14 Years' Experience, Will UNDERTAKE CONSTRUCTION or SUPERVISE CONTRACTS in any part, Europe preferred; four languages; experience in railway harbour work, &c., —"AYLSHAM," Cobham-road, Kingston-on-Thames. P4004 B

ELECTRICAL-MECHANICAL (30) DESIRES POST as ENGINEER or ASSISTANT. Thorough technical training. Apprenticeship mechanical works. Pupilage electricity generating station. Installation engineer, lay-out, erection, and working, engine and boiler plant, electrical and general machinery, lighting installations; engineer and manager small electrical power station; mechanical draughtsman on petrol engines. Last 5 years staff appointment, inspection of aero-engine manufacture and testing. Will consider appointment in testing dept. Fluent Portuguese.—Address, P4021, The Engineer Office. P4021 B

ENGINEERING STUDENT WISHES Become PUPIL-ASSISTANT to Engineer. Completed 1st year B.Sc. (Eng.) day course, Univ. Lond. Fair draughtsman, also good knowledge of geology.—Write, 153, Campbell-road, Bow, E. 3. P4014 B

ENGINEER SALESMAN, Late of Messrs. Alfred Herbert selling staff, SEEKS RE-ENGAGEMENT as Representative, any district.—Address, P4038, The Engineer Office. P4038 B

ENGINEER (25) Fitter and Turner, 8 Years' General engineering, with good knowledge millwright, jig and tools; late charge hand; energetic and tactful; home or abroad.—Address, P4025, The Engineer Office. P4025 B

ENGINEER (34), Mechanical and Electrical, DESIRES APPOINTMENT; varied experience shops and D.O. at home and abroad; accustomed to designing any type of plant, estimating, erection of factories, machinery, &c., handling of men. Responsible position as factory or works engineer or assistant with progressive firm where ability will be recognised. Excellent record can be submitted.—Address, P4050, The Engineer Office. P4050 B

ENGINEER (41), Wide Experience Home and abroad, gas engines, producer gas plants, oil engines, heavy and light; 23 years one firm, 5 years Russian oilfields, DESIRES POST, testing and inspecting home, or similar post abroad with firm of repute; excellent refs.—Address, P4022, The Engineer Office. P4022 B

J. E. A. HITCH, A.M.I. Mech. E., Who is About to sever his connection with Alfred Herbert, Ltd., is OPEN to ACCEPT an APPOINTMENT as WORKS MANAGER or equally RESPONSIBLE POSITION.—Address, 59, Queen's-road, Coventry. P3963 B

## SITUATIONS WANTED (continued)

MAINTENANCE ENGINEER (42) DESIRES POSITION, Charge of Factory Plant, Workshops, or Electric Power Plant; 4 years' chemical works experience.—A. C., 51, Castle Boulevard, Nottingham. P4042 B

MARINE ENGINEER (Scotsman), 33, Single, abstainer, ten years with B.I.S.N. Co., desirous of giving up the sea, REQUIRES suitable POST or go as partner in any small engineering or repair business in town, coast, or country. Could invest a little and give services.—Address, P4057, The Engineer Office. P4027 B

MECH. and MAR. ENGINEER SEEKS POST in Engineer's Office or Works in London; 2nd B.O.T. Cert.; exp. on construction, running, repairing of steam power plants; accept small salary.—Address, P4035, The Engineer Office. P4035 B

MECHANICAL ENGINEER, A.M.I.Ae.E., Age 31, 16 years works, D.O., administrative, DESIRES POSITION as Assist. Works Manager, Dept. Manager, or similar post, at home or abroad. Varied experience, general, I.C.E., and small parts production. Patentee. Progressive position more important than high salary.—Address, P4034, The Engineer Office. P4034 B

METALLURGICAL CHEMIST, College Trained (four years), ten years' experience with consulting chemists, mines, foundry (iron and non-ferrous), and engineering works. Research and routine experience in metallography, heat treatment, and mechanical testing. Responsible POST REQUIRED in works or foundry where scientific control of materials and products is required.—Address, P4007, The Engineer Office. P4007 B

THE ADVERTISER WISHES to MEET an UNDERTAKING of sufficient size and prospects to economically EMPLOY his experience and knowledge. Has a mind trained to handle large commercial and financial matters; a successful organiser and investigator. Accustomed to analyse facts and carry out construction or reconstruction. Plenty of common sense, energy, and experience, and a large circle of influential, financial, and business friends.
Please write, A1 at Scrippe's Advert. Agency, 13, South Molton-street, W. 1. P4032 B

YOUNG COMMERCIAL ENGINEER, 8 Years shops, costing, production, design, maintenance, research, sales, large and small works, mass production, "limit," and general work, on large variety of work; used to control men, sole charge and responsibility, demonstrating, interviewing, travelling, &c.; good knowledge of accounting, trade, finance, French; A.M.I.M.E. exam., ex Service officer, now having had sound general experience, SEEKS responsible but progressive POST. Salary secondary consideration until ability proved. Will go anywhere.
Address, P4011, The Engineer Office. P4011 B

YOUNG GENTLEMAN (23), Ex-officer, with Drawing-office, estimating, surveying, and commercial engineering training, DESIRES POST with prospects of advancement.—Address, P4024, The Engineer Office. P4024 B

ENGINEERING DRAUGHTSMAN (22), with 17 years' shops and D.O. experience, REQUIRES PERMANENT POSITION; well up in general and contractors' machinery, refrigeration, waterworks plant and mechanical filtration.—Address, P3968, The Engineer Office. P3968 B

ESTIMATING DRAUGHTSMAN in Metal Plate and Pressings; experienced; good connection and capital; SEEKS a POSITION.—C., 114, 34, Union-street, Birmingham. P4041 B

JUNIOR DRAUGHTSMAN (21) SEEKS SITUATION; 2 yrs. tech. school, 3½ yrs. workshops, 1 yr. D.O.—Address, 109, Listria Park, Stoke Newington, N. 16. P4043 B

## SITUATIONS WANTED (continued)

MECHANICAL DRAUGHTSMAN, with Wide Experience in the design and lay-out of various industrial plants, power station design, &c., DESIRES SITUATION; City office preferred.—Address, P4006, The Engineer Office. P4006 B

MECHANICAL DRAUGHTSMAN (27) DESIRES POSITION; capable and well trained, making drawings from own measurements, with 5 years' experience, 2½ of which were spent in loco. shops; good reference.—Address, P4046, The Engineer Office. P4046 B

STAMPING and FORGING FOREMAN, Wide Experience, knowledge dies, rate fixing, and heat treatment, OPEN for ENGAGEMENT.—Address, P4006, The Engineer Office. P4006 B

TOOLMAKER, DESIGN and MAKE PRESS TOOLS, JIGS and FIXTURES or TAKE CHARGE; 23 yrs. exp.; South London preferred.—Address, P4039, The Engineer Office. P4039 B

YOUNG MAN (20), Medallist Technical College, DESIRES POSITION with Contracting Firm. Knowledge of structural steel and reinforced concrete design.—Address, P4044, The Engineer Office. P4044 B

YOUNG MAN (20), 4 Yrs. Eng. Coll., Some Exp. Diesels, SEEKS SITUATION, int. comb. preferred, but not essential.—B., 5, Sefton Villas, N. Holmwood, Dorking. P4033 B

## PARTNERSHIPS

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GENTLEMAN (32) REQUIRES APPOINTMENT, Director or Responsible Post in Engineering Firm. University trained; 10 years' prac. exper. in first-class gen. engineering firms, home and abroad. Invest £1000.—Address, P3964, The Engineer Office. P3964 C

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For continuation of Small Advertisements see page iii

# Die Casting.

No. I.

By A. G. HOPKING.

THE initial difficulty in dealing with this subject lies in the need for a definition, and no one definition of the meaning of the term has as yet been generally accepted. Firstly, there is the process of casting alloys of the softer metals in iron or steel moulds, under pressure exerted by means of a machine. Then there is the simpler form of the process in which the molten metal is poured into the mould or die by hand. Thirdly, there is the casting of fairly simple objects of brass or iron in moulds made of iron.

Mention should be made of the term "chill," which is sometimes erroneously applied to the two last-mentioned processes. A chill is a piece of cast iron used by the moulder to produce one of two effects: either to produce a very hard surface on the casting due to rapid cooling, or else to expedite the cooling in order to prevent unequal contraction. In either case the chill plate forms part of a sand mould.

Taking that form of the process first mentioned, the first considerations are the advantage which it has over the ordinary sand casting or over another method of manufacture, and the uses to which articles so made can be put.

Die casting in its narrower definition until quite recently only included the alloys with a lead, tin, or zinc base, these having low melting points. The first, and for some time almost the sole successful application of the process was in the Linotype machine, in which a complete line of type is cast in steel moulds in one bar, the moulds being set together by touching a keyboard like that of a typewriter, automatically opened for the removal of the type, and returned to their proper places. In this work the molten metal has actually to pass through apertures as narrow as three ten-thousandths of an inch, a figure beyond the wildest dreams of an ironmoulder. An automatic type-casting machine can cast one at a time at a speed of 240 per minute. The success of Mergenthaler's Linotype machine in 1885 paved the way for the die-casting machines of to-day.

In the Veeder cyclometer there are twenty-four parts, of which twelve are die cast, all working in a die-cast case with a play of .0001in. Such accuracy is possible, and although this may be regarded as a special case—the company having specialised on the work for its own manufactures and patented a number of elaborate die-casting machines—yet it represents what can be done if desired. Sometimes it happens that an article can be made as a die casting when it could have been made in no other way. As an instance of this we have a firm of spectacle lens makers taking up the process in order to make a lens boring chuck which had six parts, including teeth and undercut portions, all of which had to be a sliding fit in each other. All patternmaking, moulding, and machining costs are obviated once the die is made, and, still more important perhaps, errors due to the human factor avoided. Inspections after each machining process become merged into one inspection when the casting is made. Of course, it does not follow that because an article is a die casting no machining need be done on it whatever. In certain classes of castings—aluminium-bronze, for example—some cleaning up or fettling is always necessary if the die has been in use for long. Nevertheless, with many alloys thousands of perfectly formed finished parts can be obtained from the one die. Obviously, it is far easier to get perfect accuracy once and for all in the original die than with each individual casting, and any small fins can be removed by fettlers on a grinding wheel or filing machine without jigs and fixtures and without appreciably adding to the time or cost of production. This, as has been pointed out, will only be necessary in the case of certain alloys. A further advantage over sand castings lies in the immunity from sand in the casting. Very intricate shapes are made accurately and interchangeable. Babbitt bearings instead of phosphor-bronze are made with a glassy smooth surface, whose fine hard grain is impervious to water and oil alike. Die castings are denser, more ductile, and stronger than sand castings, as shown by the following figures for aluminium:—

| | Sand cast. | Die cast. |
|---|---|---|
| Ultimate tensile strength, pounds per square inch | 20,000 | 25,000 |
| Percentage elongation in 2in. | 1.7 | 3.1 |
| Specific gravity | 2.84 | 2.87 |

A 30 lb. die casting in aluminium, if made in iron and sand cast, would weigh about 100 lb. and be only 30 per cent. stronger. This property is of considerable value.

With regard to output—and accuracy and output are the two main advantages of the process—one multiple die can produce as many as 300 small castings per hour on a one-man-operated pressure machine. Working an eight-hour day under good running conditions this will make light of an order for 5000 off. Unfortunately, such a die, with its mechanism for removing cores and ejecting the casting, takes some weeks to make, and it is in reduction of time and expense in the construction of the die that advance is most needed. The whole process is suited to quantity production, but a speeding-up of its own die production is needed. Against this remains the uncomfortable and promising fact that a cheap die does not pay. The material and workmanship must be of the very best, or life of the die and accuracy of the castings suffer. Coupled with this fact we have to acknowledge that the skilled craftsman prefers work at which he can make his money with less effort to himself. If an engineer metallurgist and a skilled die sinker got together and started a small die-casting shop they would stand a very fair chance of raising a sound business. But if a run of bad luck with the alloy occurred, owing to a failure to hit the precise mixture, a large amount of capital could be absorbed with no result. Most of the firms in the business have spent much money and time on experimental work and much yet remains to be done. In America and in Germany they are ahead of us.

Reverting to other examples of output we have an American company showing a production varying from 50 to 1500 castings a day from a multiple die taking from one to twelve weeks to make and costing from 50 dols. to 1000 dols., according to the intricacy of the article, which would be accurate in dimensions to .001in., plus or minus, in zinc, tin, and lead alloys, and .003in. with aluminium. In another case we have a hand-poured die for aluminium-bronze castings turning out on an average 100 parts a day weighing half a pound each, the die having taken four weeks to make at 2s. 3d. an hour, equivalent to a wages cost of £21. If well designed and carefully used, this die might be expected to last for 8000 off; the maximum output per die being 18,000, no mean achievement for this alloy, although as many as eight million grenade parts of one of the softer alloys were obtained from one die, cores only having to be replaced. One man, of course, cannot obtain the same output from the hand-poured die as would be obtained from a pressure machine, especially if there are a number of separate plugs and core pins to remove.

The minimum number of castings to one die for which an order can be taken will depend on the cost of the die to a great extent, and this cost will depend on the design of the article. The figure will be somewhere between 500 and 5000. In many cases the customer pays for the die directly, and it remains his property. One other point. It does not pay the casting firm to have the dies made outside, as trouble is always experienced from the die makers' ignorance of the duties to which the dies are put.

The advantage of die-cast aluminium over cast iron is found not only in the tenacity and ductility as already mentioned, but also in surface, colour, and homogeneity. Being less brittle, it can be riveted, and it is suitable for screw holes which can be tapped near the edge without chipping out. One big advantage the process possesses lies in the cost when compared with sand casting, which, for castings up to 4 lb. in weight, may be in the ratio of 1 to 8.

With regard to size, the upper limit is defined by the economics of the case. 15in. diameter oil rings and steering wheels having been cast in aluminium while a hole for a 4 B.A. tap is about the lowest diameter cored; but it can be done to limits of .003in. both in size and position.

Turning to some disadvantages, most of the die-cast alloys having low fusion points cannot stand heavy stresses. In some cases aluminium alloys with high zinc content have been said to disintegrate after a year; the same report has been made of aluminium-bronze, but without much foundation. Zinc is useless when employed in an atmosphere of ozone or sea air, and tin must replace it; furthermore, zinc will sometimes disintegrate owing to the growth of the zinc alloy constituents. Some castings of zinc base, when taken to the tropical heat of Havana, increased as much as .007in. in size. Aluminium is not an easy metal to deal with, and makers will not guarantee the same degree of accuracy with these alloys as with tin, for example. Duralumin, whose great strength is due mainly to its heat and mechanical treatment, can be die cast, but does not show any great strength. Some castings are porous and spongy in the centre. In most instances this defect can be corrected by careful design, mixing, and heating. One die, until slightly altered, gave one good casting out of ten; on a second trial sixty good and only two bad were obtained. Alloys can now be chosen to suit almost every purpose, including parts to be plated or soldered, while the uses to which die castings have been put are most comprehensive, ranging as they do from spouts of kettles to parts of trench mortars. Some of the uses of die casting may be gathered from the following list:—

*Instruments.*—Water meters, gas meters, typewriters, counters, automatic machine parts, speedometers, switches, dashpots, magneto frames, watches, phonographs, telephone and wireless sets, computators.

*Domestic Appliances.*—Sewing machines, tumbler holders, cases and lids, safety razors, window regulators, kettle spouts, cream separators, camera parts, tea spoons, vacuum cleaners, syphon parts, organs, and cooking utensils.

*Military.*—Rifles, aeroplane parts, tank pistons, parts of hand grenades, floating mines, depth bombs, torpedoes, range finders, machine gun cams, and trench mortar parts.

*Mechanical.*—Helical and bevel gears, bushes, pulleys, type wheels, machine parts, carburetters, motor pistons, radiator parts, covers for chain case and gear-box, gear cases, cycle lamps, number plates, steering wheels, oil and water pumps, lubricators, carbon brush holders, ball bearing cages.

If the limitations of the process are fully understood, and they are mainly those imposed by long and costly die manufacture and the use of low melting point alloys; if also it be acknowledged that there are cases when the die-casting process, though possible, is not the best and cheapest way of manufacturing a particular article, there still remains a large field of usefulness for die casting, and it is incumbent upon the firms of this country to become as efficient at the work as those in America and Germany.

*Metals and Alloys.*—As has been already mentioned, Babbitt and type metal were first used on account of their low melting point. Of longest standing for die casting work are the lead, tin, and zinc base metals alloyed with aluminium, antimony, bismuth, boron, cadmium, copper, iron, nickel, and silver. More recently aluminium and copper alloys have been successfully die cast. Brass has as yet been a failure in this country; at its high melting point high stresses are set up, zinc attacks the die, and the result is that less than one thousand parts can be obtained from one die.

*The Choice of a Metal.*—This is mainly influenced by the expense, strength, finish, and colour required, often also electrical conductivity, lightness, and ability to resist corrosive fluid and high temperature have to be considered. Thus zinc base alloys will be cheap, suitable for a fine plated finish, but not for contact with petrol or food, for which tin would be used. Tin gives a fine surface and colour, but is expensive. For good electrical conductivity and strength an aluminium-bronze is most suitable; light and tough aero-engine pistons will be made of aluminium with copper added up to 10 per cent., while lead is much used for bearings.

*Lead Base Alloys.*—The melting point of lead is 327 deg. Cent. and shrinkage 2.6 per cent.; its specific gravity is 11.3. It will not combine with zinc without arsenic nor with copper if above 3 per cent. Its presence is shown by the weight and colour. It is the basis of type metal and anti-friction metal, but cannot stand heavy loading. Lead and antimony unite better with each other than with any other metals, and the antimony helps to reduce shrinkage, at the same time making the alloy hard and white. Antimony melts at 432 deg. Cent., having a specific gravity of 6.7. These alloys are not strong, but, being soft, are used for bush bearings where they flow under the load and so redistribute the stresses evenly. The eutectic alloy is Pb 87 per cent. and Sb 13 per cent., this proportion giving a lower melting point than any other. Similarly, all the lead-tin alloys have lower melting points than either element alone. Arsenic was used with lead in one of the earliest forms of the die casting process, for casting bullets in iron moulds. Bismuth, with its melting point at 268 deg. Cent., expands on cooling, but forms an alloy with lead, having a melting point too low for anything else but solder, being about 100 deg. Cent.

The anti-friction metals should be below a red heat when cast. Bearings can be cast which are strong, not porous or brittle, and accurate. Some analyses are:—

| Alloy. | Percentage. Pb. | Sb. | Sn. | Fe. |
|---|---|---|---|---|
| Linotype metal | 83 | 12 | 5 | — |
| Standard white metal | 71 | 24 | 5 | — |
| Ordinary Babbitt | 80 | 20 | — | — |
| Ordinary white metal | 87.9 | 12.1 | — | — |
| Journal bearings | 85 | 15 | — | — |
| Magnolia metal | 83.5 | 16.5 | — | — |
| Melting at 288 deg. Cent. | 80 | 15 | 5 | — |
| Electrotype metal | 93 | 4 | 3 | — |
| Standard type metal | 58 | 26 | 16 | — |
| American anti-friction metal | 78.44 | 19.60 | Zn .98 | .65 |

*Zinc Base Alloys.*—The melting point of zinc is 417 deg. Cent. and its shrinkage 2.6 per cent. Like lead, it is relatively cheap and is largely used in die castings, tending to give hardness at the expense of ductility; but the average zinc base alloy is easily distorted and rarely has a tensile strength over 8 tons per square inch. Very small accurate castings can be made in this metal with holes as small as $^{1}/_{16}$in. diameter cored out. Copper added to zinc causes brittleness, but aluminium acts as a deoxidiser and gives strength, fluidity, and a good surface. The melting and mixing of a zinc alloy is not a simple matter, and when molten the temperature should be kept quite uniform. Some of the disadvantages of zinc castings have already been mentioned. In general the percentage of antimony will not exceed 2, aluminium will not exceed 1, copper will not exceed 5, tin will not exceed 19 in zinc base alloys, of which two analyses are (*a*) Zn 50 per cent., Cu 20 per cent., Sn 30 per cent., and (*b*) Zn 85 per cent., Cu 4 per cent., Sn 8 per cent., Al 3 per cent.: the first would be too brittle for many purposes.

*Tin Base Alloys.*—The melting point of tin is 230 deg. Cent. and its shrinkage 2.1 per cent. It mixes well in all proportions with lead and copper, producing alloys harder than either element, with smooth and bright surfaces. No appreciable increase in ultimate tensile strength, which for tin is 5400 lb. per square inch, is gained by adding small amounts of copper, and the tendency of zinc to start cracks outweighs any advantages it may have. Antimony adds hardness to the anti-friction qualities of tin. Tin with 15 per cent. antimony gives a hard pewter,

Tin with 25 per cent. lead will melt at 286 deg. Cent., while an alloy with more tin, some antimony, and from 2 to 10 per cent. copper melts about 360 deg. Cent. Some analyses are :—

| | Percentage. | | | |
|---|---|---|---|---|
| | Sn. | Cu. | Sb. | Zn. |
| White bronze | 65 | 4.5 | 1.5 | 29 |
| Babbitt | 85 | 5.0 | 10 | — |
| Britannia metal | 92 | 1.8 | 6.2 | — |
| Original Babbitt | 89 | 4.0 | 7.0 | — |

*Aluminium Base Alloys.*—The melting point of aluminium is 625 deg. Cent., its specific gravity 2.65, and shrinkage 8.7 per cent. Owing to its strength, colour, and lightness, this metal is becoming much used. In general, pure aluminium is increased in strength by adding zinc up to 13 per cent., nickel to 5 per cent., copper to 4 per cent., and manganese to 2 per cent. Pure aluminium is not suitable owing to its high melting point, high shrinkage, tendency to absorb iron, rapid oxidisation, and weakness at freezing point. Tin and copper and cadmium up to 7 per cent. help to neutralise the shrinkage. Zinc tends to produce hot shortness. The average alloy gives from 20,000 lb. to 30,000 lb. per square inch ultimate strength, yield point 13,000 lb. per square inch, and from 3 to 5 per cent. elongation on 2in. The metal must not be heated one degree above that necessary for pouring, for oxidisation must be reduced to a minimum, and slow cooling of the castings is advisable in order to allow the escape of the nitrogen which has been absorbed at a high temperature, particularly in big sand castings. The aluminium alloys are improved by re-melting; a 4 per cent. copper alloy having its tensile strength raised from 11,800 lb. to 15,700 lb. per square inch after the third melt. Much trouble in the past has been experienced from the high melting point, which is near the temperature which causes steel to oxidise. The molten aluminium causes pitting on the faces of dies if they are made of cast iron, forming an alloy with the iron resulting in rough castings. This defect can be overcome by choosing a suitable die material and by careful temperature control. The high shrinkage can be reduced to less than 1.5 per cent. by alloying as above.

A distinct weakness is shown at high temperatures; a 12 per cent. copper alloy suffers a reduction of tensile strength from 20,000 lb. to 9000 lb. per square inch when the temperature rises from 0 deg. Cent. to 350 deg. Cent. Both copper and zinc alloys will be weak when cold if the metal has been heated above a dull red. Recent experiments on No. 12 alloy have shown that the number of blow-holes is a function of the pouring temperature and the length of time of melting. Yet to speed up the rate of melting the fire must be fierce and overheating is then to be feared. The perfect casting is very difficult to obtain, although some very fine examples of aluminium die castings are made. Aluminium will not give such accurate castings as other white metals, nor is it always economical to cast such complications as screw threads. Internal screw threads are better machined after casting. Welding and soldering are difficult, but these alloys have been welded with the oxy-acetylene flame and soldered by coating with copper and then treating them as such. Another strong point in their favour is that they do not tarnish. Some analyses are :—

| | Percentage. | | |
|---|---|---|---|
| | Al. | Cu. | Zn. |
| Cheap white metal | 90 | — | 10 |
| General use | 80 | 3 | 17 |
| No. 12 | 92 | 8 | — |
| To pour at 663 deg. Cent. | 90 | 8 | 2 (Sn) |
| Duralumin | 94 | 4 | 2 (deoxidisers) |
| For tea stands | 70 | — | 30 |
| Best white | 84 | 3 | 13 |
| For pistons | 88½ | 11½ | — |

*Copper Base Alloys.*—The melting point of copper is 1091 deg. Cent. The only copper alloy successfully die cast is aluminium-bronze, the other bronzes, gun-metals, and brasses having failed for reasons already given. With aluminium-bronze an elongation on 2in. of 25 per cent. can be obtained, and by varying the mixture high strength in alternating stress and great hardness without brittleness may be obtained. Aluminium over 11 per cent. makes it too brittle, manganese toughens it, and iron makes it stronger, but gives it a rather higher shrinkage, and if above 6 per cent. reduces ductility. In general, a simple alloy is better than a more complicated one. When iron is introduced it should be the best pure wrought iron, and probably then exists in the bronze in the form of an iron aluminium compound $Fe Al_3$. Since it has been shown that the employment of aluminium as an electrical substitute for copper is both practicable and economical, this alloy is of considerable importance in electrical work :—

| | | | | | |
|---|---|---|---|---|---|
| Copper, per cent. | 88† | 89 | 90 | 92.5 | 95* |
| Aluminium, per cent. | 9 | 11 | 10 | 7.5 | 5 |
| Ultimate tensile strength, lb. per sq. in.— | | | | | |
| Maximum | 79,520 | 100,800 | 83,600 | 67,200 | 40,320 |
| Minimum | — | 89,600 | 73,900 | 56,000 | 33,600 |

* This alloy melts at 1038 deg. Cent. † This alloy has also 3 per cent. iron.

These figures are taken from a large number of tests.

It will be observed that the great strength is obtained without using zinc, which is always very detrimental to the die at these temperatures.

From this short account of the metals used it will be seen that a suitable alloy can be chosen for every purpose for which a non-ferrous metal casting is required. At the same time an interesting field for research lies open among the high melting point metals. Many suggestions have been made to get over the zinc difficulty in brass, such as coating the die with some non-corrosive material or adding aluminium to the alloy to form a surface film as a protection from the zinc. The solution probably lies in the latter direction, for any further complication and cost in the die must be avoided if possible.

## Developments in Power Station Design.

No. IX.*

FUTURE progress in power station practice will involve more scientific operation of the plant, and particularly of the boilers. The use of instruments for the measurement of steam, flue gas and other temperatures is steadily increasing. Stations that are being extended and equipped on the most up-to-date lines, such as the Neasden station of the Metropolitan Railway of London, are being provided with electrical distance thermometers and $CO_2$ recorders, which enable the engineer in charge to ascertain at any convenient spot the exact conditions under which the plant is working. The electrical method of measuring $CO_2$, as devised by Dr. G. E. Shakespear, of the University of Birmingham, which is being adopted at Neasden, depends upon the variations in the thermal conductivity of the gas caused by changes in the amount of carbon dioxide, and possesses the advantage that while the arrangement through which the gases actually pass is placed in close proximity to the flue, the indicator may be fixed a considerable distance away, such as on the main switchboard or in the engineer's office, where temperature indicating or recording instruments can also be provided.

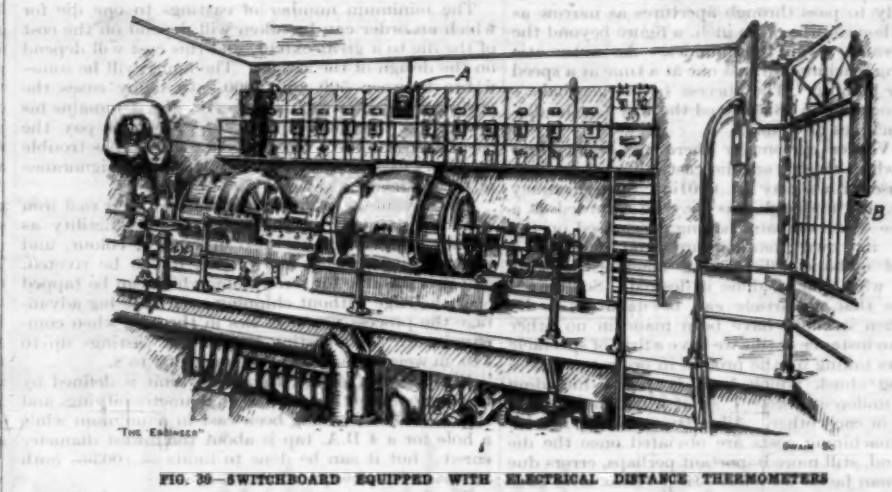



FIG. 39—SWITCHBOARD EQUIPPED WITH ELECTRICAL DISTANCE THERMOMETERS

A good idea of how conveniently all the temperatures throughout a station can be taken by means of these electrical distance thermometers is shown in Fig. 39, where the indicator itself and a plug or dial switch are situated on the main switchboard at A, and a metal conduit B carries the test wires which run to the electrical thermometers used for measuring the various temperatures, such as the steam, flue gas, circulating water, hot well and oil temperatures. All the operator has to do when he desires to ascertain any particular temperature is to put the plug of the instrument in the hole corresponding to the particular electrical thermometer it is desired to connect to the instrument, when the reading is given on the scale. Every temperature of importance can, of course, be taken periodically and entered in the log book.

$CO_2$ readings can also be taken with equal ease, for, as already explained, the indicator or recorder associated with the electrical system can be placed at any desired distance from the flue. The $CO_2$ meter contains two identical spirals of platinum wire, which are enclosed in two separate cells formed in a metal block, and each spiral is made to serve as one arm of a Wheatstone bridge circuit. When an electric current is allowed to flow in this circuit the two spirals become heated, and they give up their heat to the walls of the cells. If, therefore, these cells contain gases of different thermal conductivities the spirals cool at different rates and one is maintained at a higher temperature than the other. The difference in temperature of the two wires causes a galvanometer connected to the bridge in the ordinary way to give a deflection, and its magnitude is governed by the difference in the conductivity of the two gases, but, owing to the construction of the meter, the changes in the temperature of the gas affect both sides of the bridge equally. If, therefore, one of the coils is exposed to a pure gas and the other the same gas mixed with some other constituent, the magnitude of the deflection will be an indication of the amount of the second gas present, and the galvanometer can be calibrated to show directly the percentage composition of the mixture. An indicating or recording galvanometer can, of course, be employed.

The difference in conductivity between nitrogen and carbon dioxide enables the method to be employed to determine the percentage of carbon dioxide in flue gases, which consist chiefly of nitrogen and carbon dioxide mixed with small amounts of oxygen and water vapour, with perhaps a little carbon monoxide. Since carbon monoxide, oxygen and nitrogen have nearly the same thermal conductivity, the small variations of the former two gases do not affect the readings, and the effect of the water vapour can be counteracted by keeping the gases in both cells saturated. The difference in conductivity of the gases in the two cells then depends only on the percentage of carbon dioxide in the flue gas, but it should be noted that this method of measurement has not yet been made suitable for determining the percentage of carbon dioxide in gas such as coke-oven gas, as the presence of hydrocarbons or other constituents disturb the readings.

These electrical $CO_2$ instruments are made by the Cambridge and Paul Instrument Company in various forms, including single or multi-point indicating outfits, single and multi-point recording outfits, and combined indicating and recording outfits for single and multiple-point working. A simple recording single-point instrument—see Fig. 40—consists of a $CO_2$ meter connected by leads to a single-point recorder with a 2-volt accumulator to provide the current, a soot filter, and, if necessary, an aspirator. The recorder, shown in Fig. 40, consists of a suspended or pivoted coil galvanometer, in which the pointer is depressed every minute by means of a clockwork mechanism on to an inked thread, which is stretched above the surface of a revolving drum carrying a chart. As the pointer falls it presses the thread against the paper, thus making a dot, which forms a permanent record of the position of the pointer at that moment. Between the times of marking the pointer is allowed to swing freely and to take up its new position, so that the succession of dots forms a record of the varying positions of the pointer. The charts are calibrated to give a direct reading of the percentage of $CO_2$, and the standard range is 0–20 per cent. The four leads from the $CO_2$ meter and those from the 2-volt accumulator are connected to terminals in the small box on top of the instrument, and an ammeter on the front of the box shows whether the current in the Wheatstone bridge circuit is steady. An adjusting device is provided to compensate for variations in the battery voltage. With the aid of threads of two different colours records can be obtained on one recorder from two $CO_2$ meters. Recorders are also made to give records on a single chart from one, three or six meters. If it is necessary to obtain occasional records from a larger number of meters than can be connected to the recorder at one time a switchboard is employed, so that each of the recorder points can be connected to one of the switchblocks. A corresponding plug switch is wired to each of the meters, and any meter can then be connected to any desired recorder point by inserting the plug switch in the correct hole.

A combined indicating and recording outfit is frequently useful, as the indicator can be placed in the boiler-house, where it can serve as a guide to the stokers, whilst the recorder is placed in the engineer's office. Combined single-point indicating and recording instruments are fitted with a switch for connecting the meter either to the indicator or to the recorder. Normally this switch is held in the recording position by means of a spring, but it can be moved temporarily into the indicating position when it is desired to take readings on the indicator. Combined indicating and recording outfits for several points are also supplied. A simple indicating outfit for a single point—see Fig. 41—consists of a $CO_2$ meter which is fixed

* No. XIII. appeared September 9th.

into a pipe communicating with the flue, and is connected by leads to the indicator. These Shakespear instruments were described in detail in THE ENGINEER of October 1st, 1920, where full details of the working parts will be found. Tests made at the Central Electric Supply Company's generating station show that the difference in the readings of these electrical $CO_2$ recorders and those of Orsat apparatus is very slight, as can be seen from the left-hand recorder chart reproduced in Fig. 43. The right-hand curve shows the results of a similar test made in another works.

In addition to these $CO_2$ recorders the Neasden station of the Metropolitan Railway is being equipped with distance thermometers, as shown in Fig. 42. There is to be a 14-point instrument for measuring the temperatures of the superheated steam on each boiler, a similar instrument for measuring the temperatures of the exit gases on each boiler, a four-point instrument for measuring the temperature of the feed water at the inlet and outlet of both the economisers, and a similar instrument for measuring the temperatures of the flue gas at the inlet and outlet of the economisers. There are also to be two index thermometers for measuring the temperature of the water in the hot wells. The principle upon which these electrical distance thermometers work is that the resistance of a platinum wire to the passage of an electric current varies with the temperature. In the distance thermometers the coil of wire is made to form one arm of a Wheatstone bridge—see Fig. 44—and the other arms $a$, $b$ and $c$ are made of a material which does not change its resistance with its temperature. The coils forming the bridge are all placed inside the case of the galvanometer, which is connected as shown in the diagram. Current is supplied to the bridge by means of a small accumulator. If the resistance of the four coils $a$, $b$, $c$ and $d$ are such that $a/b = c/d$, no current will flow through the galvanometer. The resistance values of the coils are so chosen that this condition is fulfilled at the initial temperature of the range for which the thermometer is made, and any alteration in the resistance of the platinum thermometer causes a current to flow through the galvanometer and deflect the pointer, which moves over a scale calibrated directly in degrees. To test whether the current is correct a resistance of known value is inserted in the arm D of the bridge in place of the platinum thermometer. This should cause a deflection of the pointer to a defined position on the scale, but if it does not do so the bridge is adjusted until the correct deflection is obtained. A 2 or 4-volt accumulator is used to operate the instrument, according to the range of readings required, and as the energy consumed is exceedingly small the accumulator only needs charging at long intervals.

Sector-shaped indicating instruments are most frequently used on switchboards, and the various circuits can be connected up to the instrument by a plug or by a hand wheel, as shown. The instruments are calibrated in Fahrenheit or Centigrade degrees, and the scales can be made to commence and terminate at practically any temperature between —330 to +1000 deg. Fah., or —200 to +540 deg. Cent. When open readings are required over a wide range, an additional scale can be added and the change from one scale to the other can be made by means of a small switch fitted on top of the indicator. Thread recorders are also made by the Cambridge and Paul Scientific Instrument Company for recording boiler-house and turbine room temperatures, and Fig. 47 shows a portion of a chart taken from one of the other recorders are in use giving the exhaust steam oil and similar temperatures.

The resistance thermometers used in connection with the indicators and recorders above described are recorders in use at the Central Electric Supply Company's power station, St. John's Wood. This particular chart gives the temperatures of the circulating water at the inlet and outlet of the condensers, but

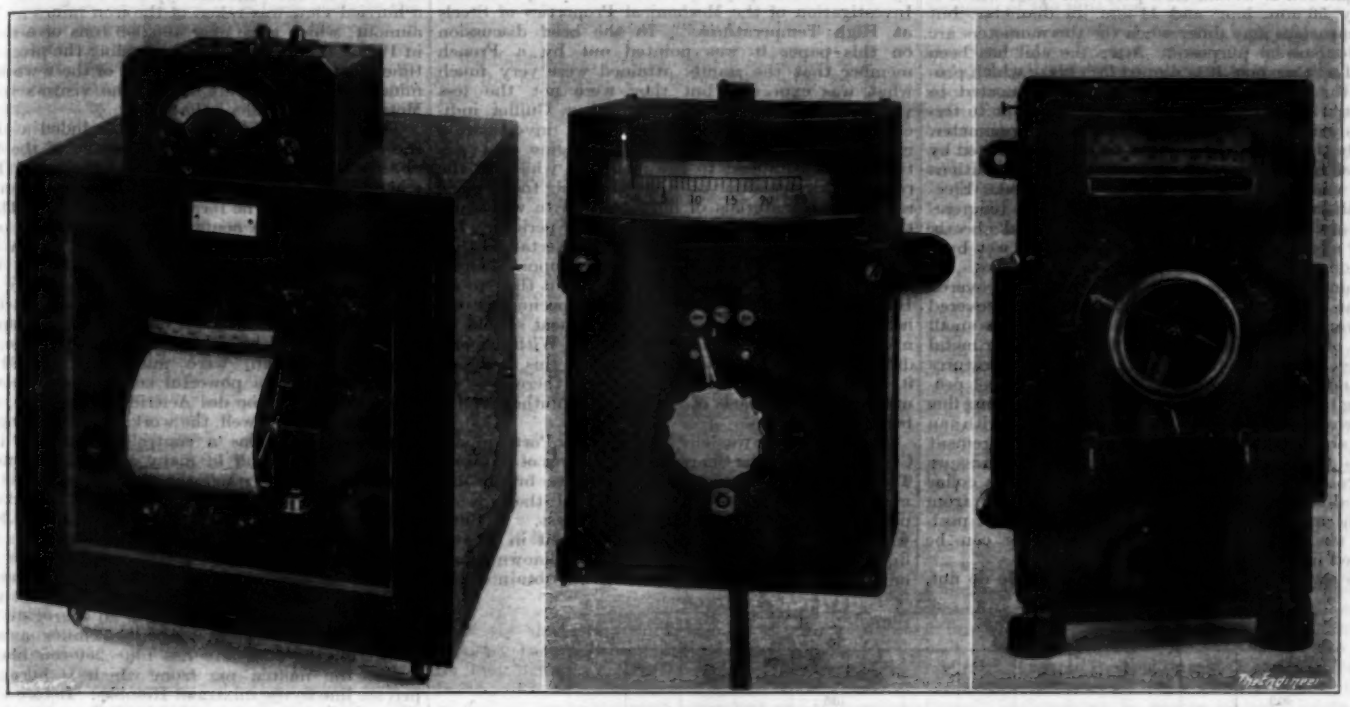


FIG. 40—ELECTRICAL $CO_2$ RECORDER

FIG. 41—SINGLE POINT $CO_2$ INDICATOR

FIG. 42—ELECTRICAL DISTANCE THERMOMETER

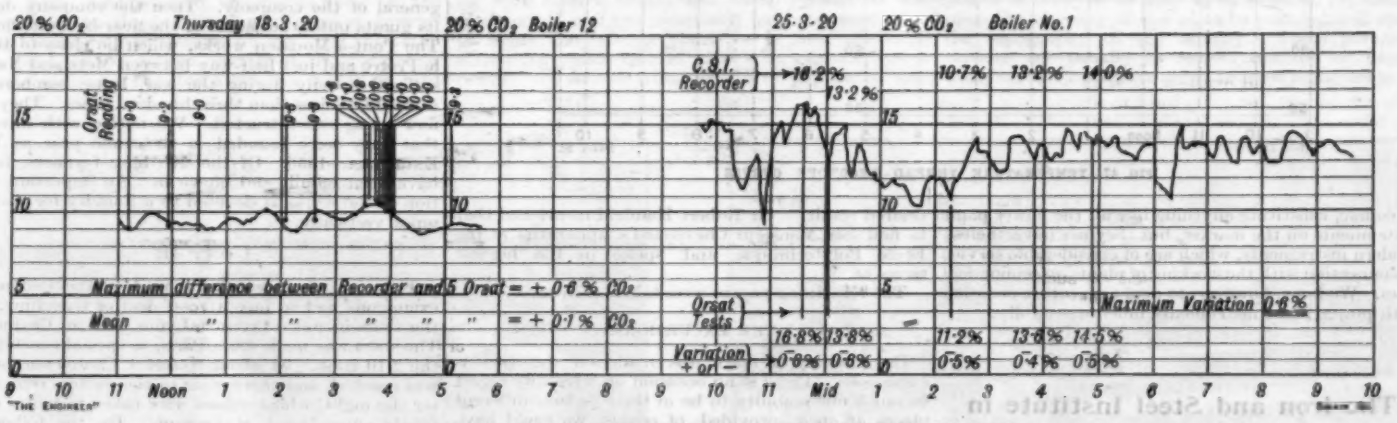



FIG. 43—$CO_2$ RECORDS OBTAINED FROM ORSAT AND ELECTRICAL RECORDERS

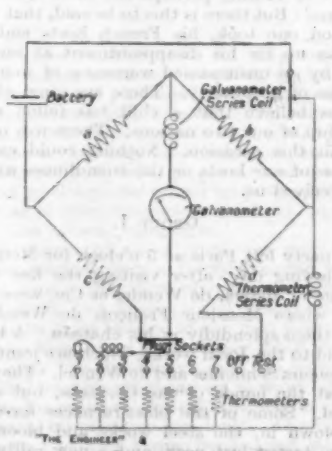
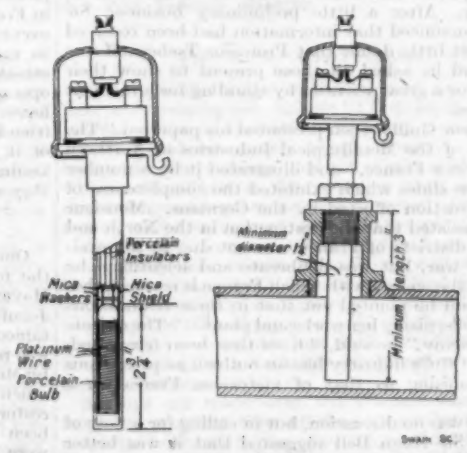



FIG. 44—CONNECTIONS FOR THERMOMETERS




FIGS. 45 AND 46—DETAILS OF THERMOMETER

protected in a number of ways, according to the conditions under which they are used, but they are all constructed on the same principles, and are interchangeable. The drawing, Fig. 45, shows the method of construction, whilst Fig. 46 shows a convenient method of mounting a thermometer in a pipe. The platinum coil is wound on a porcelain spool which is usually 50 mm. long and 11 mm. in diameter, but the dimensions may differ when the thermometers are used for special purposes. After the coil has been wound on the spool it is dipped in a glaze which protects the platinum, and the wire is connected to insulated copper leads which are brought out to terminals on the porcelain head of the thermometer. Usually the enclosing bulb and wires are protected by a metal tube having a form suited to the conditions under which the thermometer is to be used. Electrical thermometers used for measuring air temperatures are protected by a perforated metal sheath, which allows free passage to the air. In wet bulb thermometers for atmospheric temperatures the platinum coil is wound on a glass tube and covered with an aluminium sheath, which in turn is covered by strands of cotton wick which dip into a small vessel of water clipped to the bottom of the metal bracket. Thermometers for taking the temperatures of liquids in open tanks have a copper or steel protecting tube and an enclosed head. For measuring flue gas temperatures a similar thermometer with an adjustable flange is employed. For the measurement of the temperature of steam, &c., under pressure the protecting tube of the thermometer has a collar screwed with a ¾in. gas thread. Where readings from one thermometer are required in two different positions simultaneously two platinum bulbs can be inserted in one case.

The instruments referred to in this article do not, of course, constitute anything like all the power plant instruments on the market, but they are nevertheless modern instruments, which are of considerable service in connection with the working of plants on economical lines. We hope, however, to deal on a future occasion with power plant instruments much more fully.

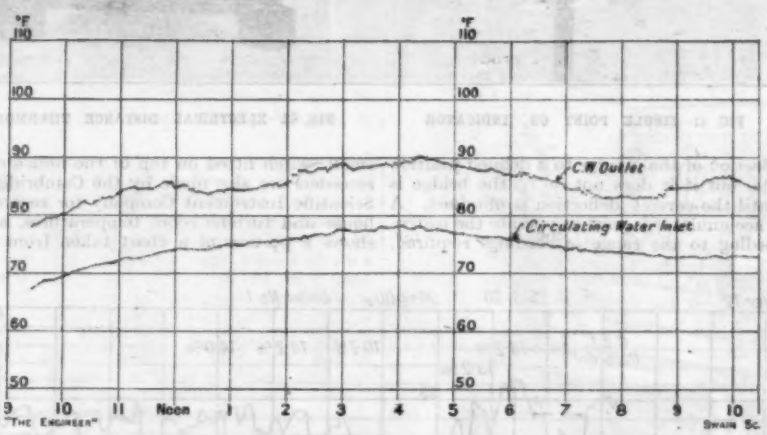



FIG. 47—TEMPERATURE THREAD-RECORDER CURVES

## The Iron and Steel Institute in France.

No. II.*

THE meetings were resumed on Tuesday morning, September 6th, in the Hotel of the Comité des Forges, at ten o'clock, with Sir Hugh Bell in the chair. After a little preliminary business, Sir Hugh announced that information had been received which left little doubt that Professor Tschernoff was dead, and he asked all those present to show their respect for a great scientist by standing for a moment in silence.

Monsieur Guillet then presented his paper on "The Position of the Metallurgical Industries in Northern and Eastern France," and illustrated it by a number of lantern slides which exhibited the completeness of the destruction effected by the Germans. Monsieur Guillet insisted that the destruction in the North and Eastern districts of France was not due to the accidents of war, but was deliberate and scientific; he spoke of the energy with which France is restoring her works, and he pointed out that in these restorations she is modernising her works and plant. "The objects of the enemy," he said, "have thus been frustrated, and the future industry has an outlook as prosperous and promising as that of victorious France as a whole."

There was no discussion, but in calling for a vote of thanks, Sir Hugh Bell suggested that it was better perhaps to think more of the future than of the past, and whilst he offered, through Monsieur Guillet, the condolences of the Iron and Steel Institute to the ironmasters of France for the destruction of their factories, he wished to couple with it the heartiest congratulations on their rapid progress towards recovery.

A paper on "Hot Drawing on the Mandril," by Monsieur Eugene Schneider, was then read in abstract, but there was no discussion on it. It was followed by a very useful and practical paper by Monsieur Dupuy, entitled "An Experimental Investigation of the Mechanical Properties of Steels at High Temperatures." In the brief discussion on this paper it was pointed out by a French member that the results attained were very much what was expected, but they were not the less valuable on that account. Monsieur Guillet indicated the practical value of the investigation in the development of the gas engine and gas turbine, and alluded to the fact that whilst in the research destruction of the material took place rapidly, the materials of industry had to withstand these high temperatures for indefinite periods. Dr. Hatfield asked a few questions, and ascertained that the curves given in the paper are based upon so many results that there can be no doubt about their form. He was inclined to think that the specimens were heated up too quickly, and that the heat should be maintained for more than five minutes. With so many different experimentalists working on this problem, it seemed a pity, he thought, that there was no unification of methods of testing. The author replied briefly.

The final paper was one by Messieurs Portevin and Chevenard on "The Characteristic Curves of the Heat Treatment of Steels," which was quite briefly discussed. Monsieur Guillet contrasted the present methods of testing with those of the past. Nothing was now left to chance; we tempered in known liquids, at known temperatures and for known times, and in 95 or 96 per cent. of cases we obtained the desired result. Sir Robert Hadfield mentioned that he had seen Monsieur Chevenard's apparatus at the Ecole Polytechnique and spoke in the highest terms of it.

The remaining papers were taken as read.

### THE EXCURSIONS.

On Tuesday a start was made on the various excursions. There is no occasion on which we regret so much our inability to be in three or four different places at once—provided, of course, we could have the endurance of three or four men—as when such trips are arranged as those of this year. To miss Creusot and Lyons would have been painful, but to see them one had to give up Lorraine and Metz and Normandy; or to see what our ally is doing with her newly acquired province one had to forego the pleasure of visiting perhaps the most famous works in France. But there is this to be said, that whatever excursion one took, his French hosts endeavoured to make up for his disappointment at missing the others by an unsurpassed warmness of welcome and openness of hospitality. There are some who would have us believe that a chill has fallen upon the friendship of our two nations. There was not a sign of it on this occasion. Nothing could exceed the kindness of our hosts or the friendliness with which they received us.

### GROUP I.

One party left Paris at 5 o'clock for Metz, and on the following day, after visiting the fine works at Hayange of Messrs. de Wendel et Cie. were taken to Joeuf, where Monsieur François de Wendel entertained them splendidly in his château. A brief visit was paid to the Joeuf works, which are jointly owned by Messieurs Schneider and de Wendel. They suffered much at the hands of the Germans, but are being restored. Some of the blast-furnaces have already been blown in, the steel works and blooming mill were re-started last year, and a new rail and billet mill is drawing towards completion. In the short time at their disposal the visitors were able to get some idea of the pace at which France is recovering. After Joeuf a short visit was paid to the works of the Forges et Aciéries de la Marine et d'Homécourt, which also suffered severely during the war, the Germans destroying the irremovable parts with scientific thoroughness and carrying off such things as gas engines and electric generators. There were in 1914 seven blast-furnaces, of which every one was laid in ruins. Two new furnaces have been built, and the steel works are being reconstructed on a fine scale and with the most modern types of machinery. Then a hurried view was taken of the iron mines at Droit-aumont, which gave over 400,000 tons of a rich ore in 1913. It was only by disregarding the programme times that anything could be seen of these works and mines, and it was late before the visitors reached Metz, where they slept that night.

Thursday was a full day, as it included a visit to the magnificent works at Hagondange of the Union of Consumers of Metallurgical Products and Industries—which were only completed in 1914—and the Rombas works. The former were begun by Thyssen in 1911, and were acquired by the present owners after the war. Here there are six 300-ton blast-furnaces, five 30-ton converters, one 80-ton tilting open-hearth furnace, and one similar furnace of 60 tons capacity. There are besides three electric furnaces, two of 10 tons and one of 18 tons capacity. The Rombas works, which, like Hagondange, were originally German, were purchased in 1919 for 125,000,000f. by a powerful combination known as the Société Lorraine des Aciéries de Rombas, which not only owns, as well, the works at Differdange and Rumelange, but has a controlling interest in the Dillingen works and in many of the Lorraine iron mines. When we recall the fame of all these great factories we recognise what vast power passed out of the hands of Germany and into the hands of France by the recovery of Lorraine. At the Rombas works there are eight blast-furnaces, of which one has a capacity of 250 tons, two of 225 tons each, and the remaining four of 170 tons apiece. The blast is provided by eleven gas engines with an aggregate horse-power of nearly 5000. About 5 miles away, at Maizières, the company has four 200-ton blast-furnaces, the molten pig from which is borne by a private line to the mixers at Rombas. Before visiting these works the party was splendidly entertained at luncheon by Monsieur Laurent, the director-general of the company.

That night the members of this group lay at Nancy, and in the morning were carried in motor cars to Pont-à-Mousson, where the works of the Société Anonyme des Hauts Fourneaux et Fonderies were rather hurriedly inspected before an excellent luncheon provided by Monsieur Cavallier, the director-general of the company. Then the company drove its guests out to see some of the near-by battlefields. The Pont-à-Mousson works, which lie close to Bois-le-Prêtre and just half-way between Metz and Nancy suffered heavily during the war, being bombarded, it is said, no less than three hundred times. They are now being reconstructed. We notice with interest that they were founded in the same year as THE ENGINEER—1856. Of the five blast-furnaces, three have been rebuilt and blown in. An important section of the works is devoted to a foundry for casting pipes vertically.

### GROUP II.

Those members who took part in the Group II. excursions had to face a good deal of travelling, for the visits included Creusot, Lyons, and St. Chamond. The start was made from Paris, in special coaches on the 2.10 train. At about 9 o'clock Chalon-sur-Saône was reached, and there some of the visitors remained for the night, whilst others were taken in motor cars to the guest-house at Creusot. On the following morning—Wednesday—a special train, provided by Messrs. Schneider, left Chalons at an early hour, and the two parties having joined at Creusot, several hours were spent in examining these wonderful shops—probably the most famous in France. Then Mr. Eugene Schneider, with Madame Schneider and other members of the family, entertained the whole group in a building at La Verrerie, known as the Jeu-de-Paume—or tennis court—to a delightful luncheon. La Verrerie, now the château of the family, was originally, as its name implies, a glass factory. Two of the huge conical glass furnace buildings have been preserved, of which one has been converted into a charming little theatre, and the other into a private chapel. In the afternoon the examination of the works was continued, and at six o'clock the special train took the party back to Chalons, whence it travelled in reserved coaches to Lyons.

We devoted, a few months ago—September 17th, 1920—a special Supplement to the works of Messrs. Schneider and Co., and we may refer our readers to it for full information about Creusot, but here we should like to lay stress upon what may be regarded as the social side of the great factories, which now employ over 20,000 persons and in which twice that number were engaged during the war. In spite of its great size, there is a "family" air about the business which is all too rare in these days. Not only does Monsieur Eugene Schneider himself, but all the members of his family, take a direct interest in the welfare of the work-people, and endeavour to preserve an attachment which recalls the conditions that prevailed in days gone by. That the workpeople respond is made evident by the fact that in the great French strike, out of the huge numbers employed at Creusot, not more than 600 could be induced to lay down their

* No. I. appeared September 9th.

tools. At the present time a veritable village of new maisonettes is arising round the works.

Many of the Schneider shops are on a magnificent scale, and we were particularly struck by a building, actually at Breuil, in armoured concrete which presents architectural features of exceptional interest. It shows that when carried out on a large scale in the broad manner there is scope for the development of a new architecture of a fine kind in factory buildings. Indeed, in our journeys through industrial France we could not but be impressed by the free use being made of concrete and by the breadth of treatment of that material. There it is being used with a courage and originality which contrasts with the nervous restraint of the employment of it in this country for factory buildings.

An early start was made on Thursday morning from Lyons and St. Chamond was reached in time for a splendid luncheon, to which the party was invited by Monsieur Thomas Laurent, the managing director of the Compagnie des Forges et Aciéries de la Marine et d'Homécourt, at his Château de Jarez. After luncheon a capital lecture was given, in English, by Monsieur Bertier, on one of the most important of the productions of the St. Chamond works—its field artillery. A particular type of self-propelling gun-carriage has been developed by the company, and was described with the help of lantern slides, cinematograph, and subsequently by actual demonstrations in the yard. These carriages are provided both with endless chain-tracks and with wheels. On the road the wheels are lowered to the ground, from which the chain-tracks are raised clear, whilst in the fields or on difficult ground the wheels are raised up and the vehicle is supported on the chain tracks alone. As the consumption of petrol is four times as much per kilometre with chain-tracks as with wheels, the advantage of the arrangement is obvious. Another extremely interesting arrangement is a petrol-electric limber with an associated gun-carriage, both on chain-tracks. The limber is self-propelling, and can be coupled either rigidly to the gun-carriage or flexibly by a long electric cable. The carriage is provided with an electric motor, by which it is driven. We hope to be able to illustrate these extremely interesting productions in an early issue.

After the lecture a hurried visit was paid to a few of the shops, as the train for Lyons left at five o'clock. The works date back to 1837, when they were established by MM. Pétin and Gaudet. In 1854 the Société des Frères Jackson, an English firm, was, with several other firms, amalgamated under the name of the Compagnies des Hauts Fourneaux, Forges et Aciéries de la Marine et des Chemins de Fer. In 1874 MM. Pétin and Gaudet retired, and M. A de Montgolfier became managing director, a position which he held until 1908. Under his management great extensions of the interests of the company were effected. Further developments were made by his successor, M. Magnin, and still further progress by M. Theodore Laurent, the present managing director. The company has now, besides the factories at St. Chamond—where guns, gas engines, locomotives, blowing engines, and so on are built—steel factories at Assailly and Loirette, tool shops at Rive-de-Gier, special pig iron foundries at Boucau, and works at Homécourt and Hautmont, which were destroyed by the Germans.

On Thursday evening the Municipality of Lyons offered this group a magnificent dinner in the beautiful Town Hall, at which the Mayor presided, and on Friday the Committee of the Lyons Fair provided automobiles and took the party for a drive through the city. Here the permanent buildings of the Lyons Fair, which are now under construction, were examined. Some idea of the importance of the Fair may be gathered from the fact that there is a whole street about 1 kilom. long of little shops on one side, whilst on the other is being built a vast range of concrete buildings, which, on their several floors, will accommodate many hundreds of similar little shops. Each of these shops is intended for the display of samples during the two annual fairs which take place in March and October, but it is proposed that some of them shall remain open all the year round. About one-tenth of the whole scheme is already completed and ready for occupation. At the Fair of last March it is estimated that there were 100,000 visitors. The Fair is subject to the usual arrangements as regards sales.

In the afternoon this group left Lyons for Paris, where it arrived about 10.30.

### GROUP III.

Members taking part in the trip to Caen and Trouville did not leave Paris until Wednesday morning. They reached Caen about one o'clock, and went straight to the Mondeville-Colombelle works of Société Normande de Metallurgie, which are situated some 2½ miles from the city. Here there are two large blast-furnaces with an extensive by-products recovery plant, and a steel works with five open-hearth furnaces and three 30-ton Bessemer converters. On Thursday morning a visit was paid to the Soumont iron ore mines, and a return was made to Caen for a luncheon given by Monsieur Eugene Schneider, who is chairman of the board of directors of the Société Normande de Metallurgie. On Friday Trouville was visited—unhappily the day was not so fine as its predecessors—and in the evening the party returned to Paris.

The arrangements on all the trips worked admirably, and on all sides were heard expressions of satisfaction with the excursions and with the cordiality and magnificent French hospitality.

## American Pipe Lines for Pumping Oil.

No. I.

IN the development of the great petroleum oil industry in the United States, the pumping of oil for long distances from the wells or producing districts to the refineries constitutes one of the earliest as well as one of the most important and interesting features. According to Mr. C. P. Bowie, petroleum engineer to the United States Bureau of Mines, the oil pipe line—introduced about fifty-six years ago—soon demonstrated such superiority that it has practically superseded all other methods for the transportation of crude oil.

This development of the pipe line system has had an important economic influence upon the oil industry, for with such a simple and cheap system for the transportation of raw material it has been practicable to locate the refining plants in or near the large consuming points instead of at the oilfields, which usually are remote from centres of population and commerce. The railway rates for the carriage of oil by tank wagons are so very much higher than those for pumping through pipe lines that if producers and refiners do not own pipe lines they can only afford to employ railway transportation for comparatively short distances. In many cases large companies have a triple ownership of wells, pipe lines and refineries. The smaller producers have their oil pumped through the pipe lines of other companies, which are "common carriers," like railway companies.

The conveyance of oil in pipes was proposed in 1860 in connection with a thirty-five-mile gravity line of 6in. pipe. Two short pipe lines were built in 1862 and 1863, but they proved unsuccessful on account of the great leakage at the pipe joints. The first of these lines was a syphon over a hill from the oil-well "farm" to the refinery, and the second was a three-mile line with air chambers at short intervals to maintain the pressure In 1865 the first practicable and successful oil pipe line was built. This line was in the western part of Pennsylvania, and was only 4 miles in length, but it was made with screw joints, which proved oil-tight and demonstrated that the plan was practicable.

A 60-mile line of 4in. pipe was completed in 1875 from the same oilfield to the city of Pittsburg. The oil was of relatively light gravity, about 40 deg. Baumé, carrying but little paraffin. In summer, the oil flowed almost as freely as water, but in the winter the paraffin would settle out of the cold oil and form a deposit in the pipe. To overcome this difficulty a winged scraper or "go-devil" was devised, which was forced through the pipe with the current of oil, thus removing the deposit and restoring the normal capacity of the pipe line.

As a result of the success of this 60-mile line, the idea was taken up and developed on an immense scale, until there is now a great system of oil pipe lines connecting the central and eastern oilfields and extending to the coast, with terminal stations and refineries at Chicago, New York, and several ports on the Atlantic coast and the Gulf of Mexico. In addition, there are extensive pipe line systems in Texas and California, the latter serving points on the Pacific coast. Several of the longer individual pipe lines are hundreds of miles in length, and some of the terminal stations are 2000 miles from the wells which supply them.

The total mileage of the trunk lines or pumping mains is estimated at 34,500 miles. To this must be added some 11,500 miles of gathering pipe lines from the wells or "farms" to the initial pumping stations of the trunk lines, making a total system of about 46,000 miles. The average cost of construction during the period when most of the pipe lines were built was about £2200 per mile of 8in. pipe, and from £43,000 to £80,000 for each pumping station. With present prices of labour and materials the cost would be very much higher. The fixed investment in pipe lines and their equipment is estimated to be approximately £130,000,000, taking the normal rate of exchange.

These oil pumping lines are generally of 8in. pipe—sometimes 6in. or 10in.—and are laid either upon the ground, or, more usually, in trenches at depths of 18in. to 36in. The pipe is of steel in 20ft. lengths, each section having one end threaded and the other end formed with a threaded sleeve or socket to receive the end of the next section. Careful cutting of the threads is necessary to ensure oil-tight joints. The weight of pipe is about 30 lb. per foot for 8in. and 42 lb. for 10in. pipe. It is required to be of sufficient strength to withstand an internal test pressure of 1200 lb. to 2000 lb. per square inch, the working pressure being from 750 lb. to 900 lb. Fig. 1 shows the pipe distributed along the trench.

Both steam and internal combustion engines are used to operate the pumps. Pumping stations are placed at intervals of from 1½ to 90 miles, depending upon the viscosity of the oil to be pumped and upon the topography of the country. These pumping stations are usually in remote country or desert districts, and constitute small isolated settlements.

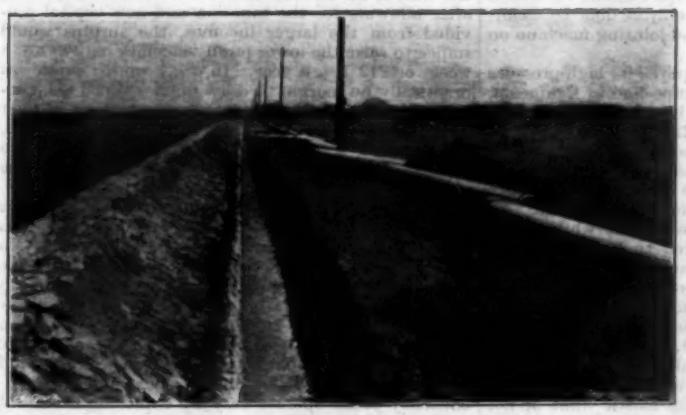


FIG. 1—OIL PIPES AND TRENCH

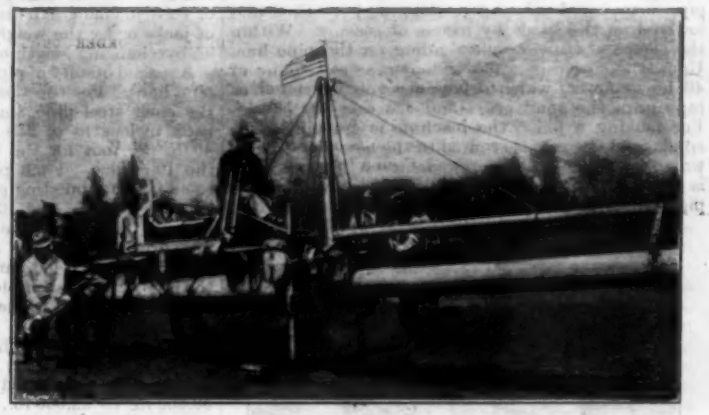


FIG. 2—PIPE JOINTING MACHINE

### PIPE LINE CONSTRUCTION.

In preparing for the construction of an oil pipe line, a reconnaissance survey is first made for the general route, special attention being given to the avoidance of excessively rough country, swampy land and river crossings, and the selection of a route which will admit of the pumping stations being situated near adequate supplies of water. On desert routes, deep wells must generally be provided for water supply. In many cases, the pipe lines are laid near railway lines, or even along the railway property. This latter arrangement simplifies the land question, as it requires only an agreement between the oil company and the railway company. It also facilitates construction and maintenance work considerably, but it sometimes gives a route less advantageous than an independent line.

Surveys are made over the selected route, and maps are prepared showing the topography and the property lines, with plan and longitudinal section. The next step is to acquire a right of way from the landowners, sufficient for pipe lines and telephone and telegraph lines. A strip of land may be purchased entirely, but the more general plan is to acquire rights equivalent to a perpetual easement, giving the pipe line company free access to the property for the construction, operation and maintenance of its lines.

Some States have granted powers to pipe line companies for obtaining the required land by condemnation or eminent domain, as in the case of railway companies.

With all preliminaries completed, construction is begun by the "right of way gang," which clears the land, removes trees and other obstructions, and prepares the way at difficult places. At railway and highway crossings trenches are dug and casings or culverts laid for the pipe. Where necessary, roads and rough bridges are built to facilitate the hauling in of the pipe. Next comes the "stringing gang," which distributes the pipe and also the poles for the telegraph line—see Fig. 1. Where the work is remote from railways this task is not easy, as the material may have to be hauled for long distances over difficult, mountainous or desert country.

At some distance behind the "stringing gang" comes the "pipe-laying gang" to connect up the pipes. This gang consists usually of about forty men for hand work or twenty-eight for machine work. As each joint is made, it is the duty of one man to see that the threaded end of the pipe is entered properly into the threads of the collar of the pipe previously laid, thus providing against cross threads, which might cause a leaky joint. To screw the pipe into the collar it is revolved by means of a rope sling until the friction is too great for further advance, and then men with pipe tongs screw the joint up tightly. With such hand work a gang will connect about 2500ft. to 4000ft. of pipe in a working day, although records of more than a mile per day have been made. Where pipe-jointing machines are used, the smaller gang will do much more work, a gang of twenty-eight men with a machine having jointed 8700ft. of 8in. pipe in ten hours, and twenty-six men with a machine having the highest record for 11,740ft. of 6in. pipe in nine hours.

The pipe-jointing machine consists of a sleeve of pipe larger than that of the pipe line, the latter passing through the sleeve, as shown in Fig. 2. The sleeve pipe is mounted on spuds or legs, and is raised and lowered on the spuds by means of gearing. Within the sleeve are small rollers riding on the pipe line. Upon the sleeve is a four-cylinder petrol engine of 40 horse-power, which drives a revolving clamp or pipe grip, the spud gears and the carrying rollers. For making a joint, the machine is set up on the spuds, and the grip is secured to the new pipe length, which is thus speedily screwed home. The machine is then lowered so that its interior rollers rest on the pipe, these rollers being then driven to propel the machine to the next joint. The operator rides on the machine, having all the control levers ready to his hand.

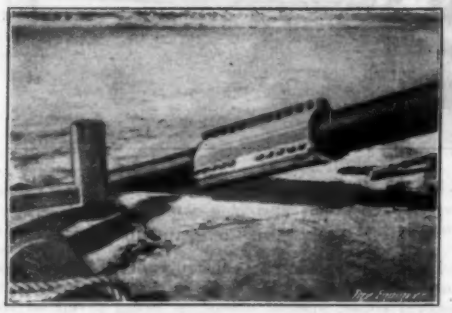


FIG. 4—REINFORCING CLAMP

When the pipe line is completed between two stations it is subjected to a hydrostatic test, during which all joints are inspected. Finally, there comes the "ditching gang" to dig the trench or ditch and bury the pipe line. Trench excavating machines are used extensively in ordinary material, and on fairly level ground, but in hilly or rough country the trench is excavated by hand, in some cases the ground being first opened up by ploughing. Blasting is resorted to, of course, when rock is encountered. The filling of the trench may be done by hand, or by scrapers operated by horses, or by engines with cables. In some cases, special back-filling machines are used for this part of the work. If the trenching is done in advance of the pipe jointing, this jointing is done with the pipes lying on timbers placed across the trench.

For the purpose of crossing rivers and streams the pipe may be laid on an existing bridge or sometimes a light suspension bridge is built to carry it. In many cases the pipe is laid on the bed of the stream, the joints being made on a raft or barge which is moved across the stream as the work progresses. The 10in. pipe of the 555-mile Yarhola pipe line is thus laid across the Mississippi River near St. Louis. To relieve the stress on the threads in the pipe at this river crossing, the joints are reinforced by clamps—see Fig. 4—each clamp being composed of three pieces which are put together to form a sleeve and bolted through the three longitudinal flanges. An expansion slip joint—Fig. 3—is also provided to accommodate stresses produced by temperature changes. For this purpose a turned pipe is fitted to a packed gland in a socket with a bolted cover like a stuffing-box.

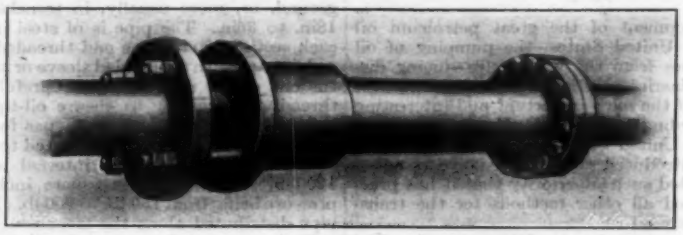


FIG. 3—EXPANSION SLIP JOINT

In cases in which the cost of trenching would be excessive, or in which the trench would be in strongly alkaline soil, the pipe line is often laid upon the surface, resting either on the ground or on sleepers. If the pipe must be buried in soil of this kind, it is usually well painted with asphaltum, and while the coating is wet the pipe is wrapped with roofing paper or felt or asbestos paper, over which is applied a second coating of asphaltum. In some cases oil is poured over the pipe in the trench, so as to mix with the surrounding soil and neutralise the alkali. Expansion and contraction movements of the pipe are provided for sometimes by shifting the pipe line in the trench so as to form a sinuous line touching opposite sides of the trench at intervals of 50ft. to 100ft.

Some of the Californian pipe lines have considerable differences in elevation, ranging from low level valleys at the oilfields and sea level at the terminals to summits of 2300ft. to 4000ft. in crossing the mountains. The low temperature conditions at the higher elevations may be compensated to some extent by laying the pipe at depths of 3ft. to 4ft. instead of the usual 1½ft. to 2ft. In making changes of direction it is usual to employ a radius of not less than 150ft. Pipe bending for lateral or vertical changes in direction may be done by means of jacks or by the weight of the jointing machine on an overhanging length of pipe.

A special quality of pipe is required for high-pressure pipe lines. For the Coalinga pipe line in California, Bessemer steel pipe 8in. and 10in. in diameter was used, in lengths of 21ft. and 22ft., with a weight of 30 lb. per foot for the 8in. and 41½ lb. per foot for the 10in. size. Each pipe was hydraulically tested to an internal bursting pressure of 1200 lb. per square inch for the 8in. and 1000 lb. for the 10in. size. An unusual feature of the test was that while under pressure the pipe was subjected to hammer blows, using either a 2 lb. hammer at 2ft. intervals along the pipe or a volley of blows from pneumatic hammers spaced 2ft. apart. The chemical specifications provided the following maximum limits:—Carbon, 0.09 per cent.; phosphorus, 0.105 per cent.; manganese, 0.45 per cent.; and sulphur, 0.045 per cent. The metal was required to show a tensile strength of 50,000 lb. to 62,000 lb., with an elastic limit of not less that half the tensile strength, the elongation on an 8in. length to be not less than 20 per cent., and with a reduction in area of not less than 50 per cent.

## The British Association.

No. II.*

The annual meeting of the British Association for the Advancement of Science opened at Edinburgh on Wednesday of last week under the presidency of Sir Edward Thorpe. An extract from Sir Edward's presidential address was printed in our last issue, together with the first portion of that delivered by Professor Gibson to Section G (Engineering). Professor Gibson's address is concluded elsewhere in this issue, while below we begin our report of the proceedings of those sections the work of which is of more especial interest to engineers.

### SECTION F.—ECONOMIC SCIENCE AND STATISTICS.

#### The Wages Problem.

Besides the presidential address of Mr. W. L. Hichens, which dealt with the principles on which wages are determined, several other contributions were made on various branches of the same subject.

The breakdown of the minimum wage was the topic attacked by Mr. A. A. Mitchell. To the man in the street, he said, no proposition appeared more axiomatic than that wages should depend on cost of living. If a wage was insufficient to provide its possessor with sufficient food, housing and clothing, according to some standard in the critic's mind, for himself and a family of normal size, it was condemned as inadequate without further inquiry. It followed that if the price of these things rose, the wage must rise with it, even if the rise were due to a general destruction of wealth. A minimum or living or standard wage ought then, as a general idea, to be an absolute first charge on all industry.

Economists had unfortunately failed to come forward to combat this theory in recent wage controversies, and it would almost seem that those who knew better were content to acquiesce in popular error. In Mr. Mitchell's views the attempts to prescribe by law or opinion or trade union action an irreducible minimum standard of life was just the principle of the grant in aid of wages of the old Poor Law. Did it make any difference that the obligation was placed on industry in the abstract and on the employer in the concrete instead of on the community in the form of poor rates? The subsistence theory did not require that every particular workman should be kept alive. Where labour was abundant or there were indefinite reserves of labour it might pay to use up the labour and hire fresh. A whole race, if industrially inefficient, might, indeed, disappear without derogation to the theory. The criticism that must be passed on the standard wage system was that it totally ignored the fact that wages were a payment for work done. To base them on an assumed standard of living was to base them on what to the employer was an irrelevant consideration. A wage that was paid for work done must bear some relation to the value of the work. That value might be very much above or it might be below the assumed standard of living. Under the system of production for profit no one was compelled to be an employer at all. No one, therefore, could be compelled to employ on terms that he thought unprofitable to himself. Much less could he be compelled to go on employing at a loss. And yet wages fixed with reference to standard of living might involve a loss to the employer. If the employer were regarded as a mere intermediary, the result would not be different. The industrial system would appear as a system where every worker exchanged his product for what he needed or desired. The basis of the system was that there is some equivalence between what is given and what is received. In such a system there was no room for payment according to a pre-determined standard of living. We were getting very near to the position of being asked to divide in wages all, or more than all, the wealth of the country. Sir Josiah Stamp calculated that before the war, if all incomes above £250 had been pooled, after allowing for the taxation and new capital provided from the larger incomes, the surplus would suffice to raise the lower family incomes only by 5s. a week, or £12 10s. a year. In other words, there was practically no margin to draw upon. When one considered the increasing difficulty of finding a market for the product at a price which would pay the wage, especially in the export trades, one was forced to wonder whether there was enough wealth in the country to pay even present wages.

A wage based on standard of living having, *ex hypothesi*, no relation to the value of the work, was also fatal to efficiency and increased production. No doubt it was possible to remunerate, beyond the standard, the workman of extra efficiency, but no degree of inefficiency could bring the workman below the standard wage. Opponents of competition often claimed that, if competition in price or wage or rate were abolished, competition in efficiency would remain. But with a minimum wage competition inefficiency could operate only by depriving a man of work altogether. There was no reason why the relatively inefficient man—it might be the old workman or the disabled soldier—should not be employed at a wage proportioned to the value of his work.

Mr. Mitchell concluded by reference to the manner in which recent industrial disputes had been handled. In the case of the Coal Commission, the spectacle was presented of the testing of remuneration by the application of an ideal standard which had little or no reference to the value of the miner's work or what the industry could afford to pay. That was even more obvious in the Dockers' Inquiry. It would be in everybody's recollection that the main stress was laid on the claim that the docker should have a fairly high standard of life as an absolute right without reference to other considerations. In the case of the recent coal strike it would have been imagined that it was accepted as a matter of course that wages must be reduced to the point which admitted the industry to be carried on. It was no answer to say that the reduced wages left the miners little to live upon or less than they had in 1914. Neither was it any answer to say that the good mines might be made to pay for the bad. Under nationalisation itself, no Minister of Mines could justify spending 25s. on any individual mine in order to extract coal worth only £1.

Mr. Mitchell wound up on a more optimistic note. The miners' wages question was, he said, now settled, one hoped, satisfactorily. Other trade unions had shown a reasonable readiness to accept wage cuts. It had to be remembered, however, that the gulf to

* No. I. appeared September 9th.

be bridged between costs of production and the prices obtainable, especially for export, was wide, and that wages formed so large a part of cost of production, that only by drastic reductions of wages could the gulf be bridged.

Professor A. W. Kirkaldy dealt with possible developments of the wages system.

The great defect of the wages system had, he insisted, been the flat rate. It, though probably at one time a necessary stage in development, entailed considerable injustice on the more ambitious, energetic, and skilled members of the labour force. The time was overdue for a further development which might rectify, at any rate, the more glaring of the inequalities. There was, of course, a great difference in the viewpoint of labour and the viewpoint of the employer. The all-important thing to labour was the wage rate. The all-important thing to the employer was the cost of labour. The employer who consulted his wages book without correcting the impressions gained therefrom by a careful system of costing, which gave him the true cost of labour, was, by speeding up, acting contrary to his own true interests. So long as labour cost was low, it was obvious that the wages received by the individual worker, however great their amount, should only receive very secondary consideration from the employer.

In America of recent years a new policy had been inaugurated, and was known by the now familiar term "scientific management." A whole library of books had been written on the subject. There was much in it that was good, there was a good deal that was doubtful, and there were some things that were more than doubtful. Many of the better parts of scientific management had been practised in the best factories and yards in this country for decades. So far as scientific management affected the material side of the worker, the American system called for a good deal of criticism. Briefly stated, that policy required, on the one hand, that fatigue and a number of psychological phenomena should be carefully studied, and a system adopted which was based on ascertained facts, calculated to prove beneficial to all concerned. On the other hand, it stipulated that only supermen should be employed. So long as that policy was only adopted by a limited number of firms, they would reap very considerable benefit, while the supermen they employed would earn comparatively high wages. But if that policy were universally adopted in a country like the United States, it would mean that a comparatively small proportion of the industrial force would be employed, that its members would earn exceptional wages, but that all men of, or below, average ability would find no employment in manufacturing industries.

It would be said that scientific management, so far as the employment of labour was concerned, would become a brutal policy, and that it would hardly be permitted by the trade unions, nor practised by the most progressive employers. An alternative policy must be sought. It would require the best brains of the country to investigate the subject and a vast amount of patience and willingness to give and take on the part of both employers and employed if a solution, even when discovered, was to be widely adopted. He desired to direct attention to a policy which was worked out in connection with the brass-workers of this country by Mr. W. J. Davis and Mr. Evered, of Birmingham. Summed up in one phrase this policy entailed a "grading of labour." Under it the ability of each worker was graded, and he was paid a wage commensurate with his skill and ability. As originally applied, the grading authority consisted of a board including employers, representatives of labour, and of the local technical school. The grade and a rate of pay could be increased from time to time by the individual workman appearing before the board and proving that he had attained additional skill or capacity. That experiment, though tried on a comparatively small scale, was well worthy of investigation, and probably of a considerably extended application. The main difficulty was to set up an adequate grading authority. It had been suggested that the time might be ripe for a further development in industrial relations, that the functions of trade unions and the position of trade union officials might, with advantage, be enlarged, and that part of this new development might include an active share in extending that new policy. Was it practical politics at the present time to make a somewhat drastic change in the whole wages system? Could an experiment be made in connection with one of our industries where the conditions of employment were comparatively permanent, in order to test the possibility of utilising the machinery of Industrial Councils or Standing Joint Committees to assess the share of production which was due to manual labour, and then to hand that share at convenient intervals, as might be arranged, to the officials of the union or unions concerned. Under that system the unions themselves would be responsible for the grading of their members.

## SECTION B.—CHEMISTRY.

A group of papers on surface tension phenomena dealt with various branches of this interesting subject.

The measurement of surface tension over a wide range of temperatures was treated by Professor F. M. Jaeger. He described and illustrated a method which permits the accurate determination of surface tensions between − 80 deg. and + 1625 deg. Cent. In this method a slow current of nitrogen enters the liquid through a platinum capillary immersed to a known depth, so that small gas bubbles are formed at the sharp edge of the tube, and the minimum gas pressure needed to cause the gas bubbles to burst is measured. This pressure is connected in a known way with the radius of the tube, the density of the liquid at the temperature given, and the surface tension sought. The method has been applied to many organic substances and inorganic salts.

Another branch of the subject was raised by Mr. Cosmo Johns in a paper bearing the title "The Surface of Liquid Steel." The author said that when a liquid steel surface was observed with an optical pyrometer the difference between the optically clean liquid surface and the surface having films of oxide floating on it was very apparent. If liquid steel were poured into an open mould the time that elapsed from the end of pouring until the surface clouded over as the oxide films formed could be used as an approximate measure of the original temperature, oxidation taking place as the freezing point was nearly approached. Solid steel oxidised the instant a freshly cut surface was exposed to the atmosphere; liquid steel remained unoxidised for an appreciable time. The question arose, What was the nature of the protecting medium, and why it should be so effective at temperatures high above the freezing point and non-effective in the neighbourhood of the solidification point? The obvious suggestion was that the liquid surface was protected by its own vapour, and that the vapour pressure was greatest at high temperatures and practically non-existent near the freezing point. Experiments were made to throw light on these points, and the assumption that liquid steel is protected from oxidation by its own vapour was shown to be correct. It was proved that the fume rising above and floating away from the surface of liquid steel consisted of small globules of oxide of iron. Experiments were made to determine the origin of the fume and to ascertain if the minute globules represented the vapour phase after condensation and subsequent oxidation. Samples were collected from steels of known compositions, the assumption being that if the fume represented condensed vapour, differences would be apparent for various ingredients of the steel. Choice was made for the critical test of a nickel-chromium alloy containing some manganese, and the test gave the final proof to the correctness of the theory that protection from oxidation in liquid steel is given by the protecting atmosphere of its own vapour.

Surface tension in the solidification of metals was the subject of a short contribution by Professor C. H. Desch. He stated that he had examined and compared the forms of the grains in solidified metals with those of foam cells, and had found a close correspondence, indicating that the form of the grain boundaries was determined by surface tension.

## SECTION G.—ENGINEERING.

### TIMBER FOR AEROPLANES.

A report of an inquiry carried out for the Ministry of Munitions and the Forestry Commission into the suitability of Scottish-grown timber for aeroplane work and pit props was brought up by Professor T. Hudson Beare. The investigation began, it was stated, during the war at a period when the difficulty of obtaining supplies of foreign-grown timber threatened to become acute, but was of importance in connection with the requirements of the future. The samples sent were tested as beams on a 20in. span, the load being so arranged that there was no shear stress on this central 20in. From the unstressed ends of every beam specimens were cut and turned for compression tests. In the case of the beams a deflectometer was used in order to determine carefully the limit of elasticity. After the beams were broken tests were made of the percentage of moisture present, measurements were made of the width of the annual rings and of the nature of the growth of the wood. Hundreds of samples were tested, but Professor Hudson Beare is unable at the present time to give the detailed results. He intimated, however, that the work done gave proof that a light Scottish pine would be an admirable timber in aeroplane construction. There was also a heavier wood that could be used. Tests of wood which it was thought might be suitable for pit props were made of pine, spruce, larch, and other timbers. The props varied in diameter from 2½in. to 9½in., and quite recent tests had given very satisfactory results. Specimens of imported props which were tested gave practically the same figures as those for Scotch timber.

Some figures dealing with the mechanical properties of Scotch pine were submitted by Professor Alex. R. Horne. Experiments had been made, he said, upon about 300 test specimens taken from six forests in the North of Scotland. The specimens were of a size such as is used in constructional work. Laws have been established giving the relations between breaking strength, elasticity, and dry density. Information has been obtained regarding the percentage of moisture in the trees as cut, and its distribution. The rate of loss of moisture during seasoning has been investigated, and the period of seasoning desirable in practice has been determined. It was shown that the cross breaking strength and elasticity reached a maximum when the dry density was about 33 lb. per cubic foot. The cross breaking strength of the home-grown timber compared very favourably with that of foreign timber of the same class.

The tone of the discussion suggested that as a result of these experiments and others now in progress Scotland would in future be largely self-supporting for timber supplies.

### STRESSES IN SHIPS' PLATING.

The effect of stresses in ships' plating due to fluid pressure is of great importance to the engineer. It finds special application in the design of sea-going vessels where the plating forming the skin of the inner or outer bottom and the diaphragm of water-tight or oil-tight bulkheads are called upon to withstand stresses due to fluid loads, in addition to those resulting from bending moments to which the structure as a whole or locally may be subject. A paper presented by Dr. Bernard C. Laws dealt with one aspect of this subject, *i.e.*, mild steel plates of rectangular area fixed along their edges or boundaries and subject to uniform fluid pressure. Such plates are commonly met with in practice, yet, as Dr. Laws pointed out, there were few instances in engineering literature wherein there was such a dearth of information to guide the designer in assigning dimensions to materials. The plating under the load suffers deflection, in consequence of which direct tension is experienced affecting the resultant stress, not only by virtue of its own value, but by the bending moment which it exerted on the material apart altogether from that resulting from the action of the direct load.

It seems, at present, that the determination of stress is only possible by subjecting the plating to experiment and making a mathematical analysis of the derived data. So far as the author was aware, no conclusive experiments had been carried out on stiffened or reinforced plates, and only a few instances were known where free plate areas had been so treated.

Until comparatively recently, Grashof's expressions afforded the only aid to designers, but it had come to be realised that the results obtained thereby were wide of the truth. If $a$ and $b$ denoted the sides of a rectangle and $n = a/b$, these expressions might be written thus:—

$$\text{Maximum stress} = p = \frac{n^4}{2\,(n^4+1)} \cdot \frac{w.b^2}{T^2}$$

$$= f(n) \cdot \frac{w.b}{T^2}\,2$$

$$\text{Maximum deflection} = \delta = \frac{n^4}{(n^4+1)} \cdot \frac{w.b^4}{32\,E.T^3}$$

$$= \varphi(n) \cdot \frac{w.b^4}{32.E.T^3}$$

where $w$ = unit load on, and T = thickness of, the plate.

That the expression for $p$, at least, was unsatisfactory seemed, said the author, to be indicated by the fact that plates recovered and experienced long life after being repeatedly subjected to loads which, according to Grashof, should be sufficient to break them down.

Crawford, whose work has been published in the "Proceedings" of the Royal Society of Edinburgh (Vol. XXXII.), experimented on a number of small planished steel plates, and concluded that Grashof was about correct for deflections, but for stress was about 25 per cent. low. Steel, surface treated in that way, was likely to give, for the same deflection, stress values much in excess of what would be anticipated with ordinary mild steel direct from the mills, and it might be that his conclusions had no application to the material in general use for constructional purposes. Montgomerie had also made experiments on mild steel plates, and work on the same subject had, the author reminded the meeting, been done by Bruhn and Boobnoff. Dr. Laws suggested, as a result of his own work, that the greater principal stress at the middle point of the longer side $a$ of the rectangle was the maximum stress for the plate, and the functions $f(n)$ and $\varphi(n)$, previously referred to, might be represented by

$$\frac{n^2}{2\,n^2+6.5} \text{ and } \frac{n^4}{n^4+2}$$

respectively. It was considered that these expressions gave results which were not far from the truth, and might be usefully employed in design.

Turning to actual practice, Dr. Laws said that naval architects had been in the habit of making what they deemed reasonable assumptions in assigning scantlings to vessels. The increase in scantlings with the development in size of floating structures during recent years had, however, caused the designer to turn his attention to the question of economy of materials, and the idea that the thickness of plating might be reduced had received encouragement from the fact that stresses induced by fluid pressures were not so great as had been believed. Bottom plating had seldom been found to fail in practice. Dr. Laws quoted examples to show that stresses in vessels constructed on the longitudinal system were much less than those for the transverse framed vessel, and enabled a more economical distribution of the material to be made. In the latter part of the paper the author dealt with the question of stiffened or reinforced plates, and in the absence of a complete experimental investigation endeavoured to trace the effect of the rein-

forcement in bringing about a re-distribution of stress in the material.

### FRACTURE OF WIRE IN STEEL ROPES.

A paper by Dr. E. M. Horsburgh dealt in the first place with the mathematical principles involved in examining the strength of steel ropes and the fracture of rope wires, and made an endeavour to show how some problems connected with such ropes concerning which no general agreement had yet been obtained could be solved. The author gave a summary of a series of tests of new rope wire and tests of wires from worn ropes which he had carried out at Messrs. Brunton's research laboratory. The usual treatment of inclined cords supporting a load, he reminded the meeting, was to resolve the forces vertically and horizontally by the usual statical method. The hypothesis on which this method was based required, in his opinion, to be reconsidered. The author proceeded to consider the effect of combined stresses experimentally and theoretically, as in practice bending stresses were superimposed on the tensile stresses. In a later section of the paper he dealt with the modulus of elasticity of the rope, and commented on the manner in which it had been confused with Young's modulus. The stress strain curve of a rope was contrasted with that of a structural member which could not be represented by a single function of one variable, whereas it was shown that a rope could be so represented. The gradient of this function was the rope modulus. An analytical expression was suggested, and an attempt made to fit this to the data. Finally, Dr. Horsburgh dealt with the wires of ropes in actual use and quoted results of tests on worn ropes which had suffered from abrasion and denting.

### WIDTH OF SPECIMEN AND TENSILE TESTS.

The influence of the width of specimen upon the results of tensile tests of mild steel and rolled copper was the subject of a paper by Professor T. Hudson Beare.

The research, it was stated, originated in an attempt to re-establish the critical ratio of width to thickness which Barba had shown to give a maximum elongation, but the scope of the investigation ultimately became much wider.

The research comprises three distinct investigations. In the first place, a preliminary examination was made into the effects of varying the width of specimens cut from ¼in. mild steel plate which was obtained locally. Thereafter, a somewhat similar, but much more careful, investigation was carried out on specimens cut from ¼in. mild steel plate which was specially made for experimental purposes, but which, unfortunately, was over-annealed during heat treatment. The greatest width of bar taken by the 100-ton testing machine in the engineering laboratory of the University of Edinburgh is 4in.; so that with this thickness of plate, the ratio of width to thickness could be increased to nominally 32 : 1 as compared with 16 : 1 in the previous work. To determine whether the results obtained in the case of mild steel were peculiar to that metal or common to other ductile metals which fail with marked local contraction, a third investigation, on lines similar to those adopted immediately above, was conducted on test pieces cut from ¼in. copper plate also obtained locally and of unknown origin.

The carbon content of the ¼in. steel, as indicated by micro-analysis, lay between 0.12 per cent. and 0.15 per cent., and that of the ¼in. steel, as stated by the makers, was 0.13 per cent., the quality of the latter being known as "welding boiler." The copper was practically free from arsenic, and micro-analysis revealed the normal structure.

The plates were sawn into bars 18in. long in the direction of rolling, and of the required widths. Three bars of each width were obtained from the ¼in. plate and four from each of the ¼in. plates. Bars of a width were clamped together and machined on the edges; and the mill scale on the faces was removed by light grinding on the sandstone. By this procedure a fairly uniform section was obtained. Each result recorded is the average obtained from independent tests of three or four bars as the case may be.

The centre line of each bar was divided, for its entire exposed length of 12in., into 1in. lengths in the earlier investigation, and into ¼in. lengths in the two later inquiries, a scribing board and steel trammel being used for this purpose. The extension of bars breaking at some distance from the centre of their length could thus be computed as for fracture at that point. Bars which broke near the grips, or which developed two waists before rupture, were rejected and replaced. The utmost care was taken to ensure axial application of the load, and to secure uniformity in the rate of its application; the same straining speed was employed throughout the tests—about 0.12in. per minute or 1 per cent. per minute on the 12in. length between the grips.

The yield point was found to remain practically constant over the entire range of observation in each case, the average value being 18.14 tons per square inch for the ¼in. steel, 12.82 tons per square inch for the ¼in. steel, and 7.32 tons per square inch for the ¼in. copper. The width of the test bar, therefore, appears to have no appreciable influence upon the elastic strength of mild steel or rolled copper. The tenacity, or commercial maximum stress, also appeared to be but little affected. In the case of the two steels there was a slight tendency to rise as the width was increased, but this effect was noticeably absent in the case of the copper. The average values were 25.48 tons per square inch for the thicker steel, 22.37 tons per square inch for the thinner steel, and 14.52 tons per square inch for the copper.

### RESCUE APPARATUS IN MINES.

Professor Henry Briggs described two new forms of rescue apparatus for use in mines. One was the improved aerophor (liquid air) apparatus, and the other the Briggs (compressed oxygen) apparatus. The author stated that it was with a view to complying with the more stringent requirements as applied to breathing apparatus in mines now stipulated by the official regulations that these appliances had been designed. The improved aerophor apparatus had been worked out by the officials of the Newcastle and Mansfield groups and rescue stations, and embodied improvements in the receptacle for holding the charge of liquid air, in the purifier for abstracting the carbon dioxide from the air, and in the valves and general construction of the apparatus. In the Briggs apparatus several improvements had been introduced. The oxygen was contained under pressure in a single cylinder, and it was supplied to the breathing circuit of the apparatus through a valve gear of special design. The headpiece, mouthpiece, flexible tubes and breathing bag were the same in each apparatus.

## TRIALS OF GERMAN ARMOUR PLATES.

TRIALS have recently been undertaken to test the quality of various types of German armour plates for the purpose of comparing them with plates of corresponding thickness manufactured in this country. The plates were obtained from the ex-German battleship Baden, and are therefore thoroughly representative of the German product. The following table, setting forth the results of these trials, indicates the marked superiority of British armour plates. In the table the average limiting velocity of penetration for British plates is taken to be 1000ft. per second in each case, and column 3 shows the comparative figures for German plates. The shells used for the trials were of similar mark and quality to those used in testing British plates of the same thickness.

| Thickness of plate in lb. per sq. inch. | | Index number representing limiting velocity of penetration. British. | German. |
|---|---|---|---|
| 80 .. | Bulkhead plate .. | 1000 .. | 1009 |
| 160 .. | Turret roof plate .. | 1000 .. | Less than 955* |
| 200 .. | Do. .. .. | 1000 .. | Less than 935* |
| 320 .. | K.C. armour .. .. | 1000 .. | 940 |
| 400 .. | Do. .. .. | 1000 .. | Less than 895* |
| 480 .. | Do. .. .. | 1000 .. | Less than 835* |
| 560 .. | Do. .. .. | 1000 .. | 915 |

In the cases marked with an asterisk, owing to the limited space available for attack, the velocities could not be taken low enough to determine the limiting velocity, the shells, at the velocities indicated by the index figures, passing on practically undamaged, except in the case of the 200 lb. roof plate.

## River Conservancy in Colombia.

IMPROVEMENTS in the financial condition of the State of Colombia, coupled with the promised payment, towards the end of the current year, of the 25,000,000 dols. due from the United States in final settlement of the Panama Canal dispute, will enable the Government to proceed with a number of projects long contemplated, but hitherto impossible, owing to the lack of funds. It is proposed to advance the necessary sums to Departments, such as that of Bolivar, for the building of a number of roads and the clearing of navigable rivers; these undertakings have hitherto been impossible, although recognised as likely to have a marked influence on the economic progress of that province. New roads are projected from Sincelejo to Ayapel, and from Cartagena to Barranquilla.

Engineering commissions have been appointed to report upon the advisability of dredging the Dique connecting Cartagena with the Magdalena River at Calamar, and also the Sinu and Atrato rivers. It is expected that taxes levied on buildings and factories situated on the banks of these rivers will bring in sufficient revenue to pay for their dredging and upkeep.

Another project to be undertaken will be the clearing of the Magdalena River mouth, which dries up annually. The result is that transportation between Antióquia and the coast is difficult, and attention has been turned to the Atreto valley, where alternative relief may be found. Dredging has been carried on by the Government on a small scale for many years as maintenance work, but the efforts put forth have not been sufficient, and the river is gradually being lost through lack of necessary reclamation work. In many places the stream has spread out to such an extent into swamps, small lakes and new channels that traffic has been affected even when the river has been normal. In a dry season, such as that which occurred, for instance, in the summer of 1919, steamship traffic is so seriously handicapped that the journey from Barranquilla to Bogotá, taking normally eight days, is increased to between fifteen and twenty days. The Magdalena River steamers draw only from 2½ft. to 3½ft., but the river is in such a poor condition that even with this shallow draught a steamer seldom makes the round trip without having lost several days stranded on sandbanks. The river reclamation work will be carried out under the superintendence of the Minister of Public Works, Bogotá, but more directly under the Junta de Canalisación del Rio Magdalena. A powerful dredging apparatus is required for the clearing of the silt from the mouth of the Magdalena, which, it is claimed, might remain open and make navigable this waterway at all seasons of the year.

Besides these river improvment schemes attention is being given in Colombia to several other classes of engineering work. Thus plans have been completed for the erection of a new electric light plant suitable for the growing requirements of the city of Cartagena, while the Municipal Council is ready to receive proposals for a new telephone system, the cost of which, including buildings and plant, with a capacity of 1600 lines, should not exceed £15,000. The Government is contemplating the establishment of a long-distance inter-urban telephone service to be operated in connection with the telegraph service, which is Government owned. The principal telegraph offices will be provided with improved equipment. The work is to be carried out under the supervision of the Director-General de Telegrafos.

Sanitation works are to be begun at Puerto Colombia, the principal port of entry to the Republic, which will include the construction of a water pipe line, to supply the city with water, from Barranquilla, 17 miles distant. At present Puerto Colombia is supplied by tank cars run on the railway. Among the improvements also contemplated is the erection of a new Customs House at Barranquilla.

## Letters to the Editor.

*(We do not hold ourselves responsible for the opinions of our correspondents.)*

### POWDERED COAL FUEL.

SIR,—In the July 8th, 1921, issue of your paper there appears a letter to the Editor entitled "Powdered Coal Fuel," which is misleading because some of the statements are erroneous. The first commercial installation for burning pulverised coal under boilers was made at the Parsons shops of the M. K. and T. Railroad in 1916, ante-dating by two years the Oneida plant of the Milwaukee Electric Railway and Light Company.

The Parsons installation was made under eight 250-horse-power water-tube boilers, which went into commission during August, 1916, six of them being operated continuously for three years until oil was obtainable at such a low price as to warrant its use. Since then this plant has been operating alternately on pulverised coal and oil, the fuel selected depending on the prevailing prices. Recently gas has been discovered within 20 miles of this installation, and it is quite likely that this fuel will also be used.

H. A. REICHENBACH,
FULLER ENGINEERING CO.

Allentown, Pa., U.S.A., August 24th.

### RIGID AIRSHIPS.

SIR,—I read with interest the unsigned article "A Lesson from Past Experience," published on the 2nd inst. in your excellent journal. The author has evidently taken great pains to demonstrate what a terrifying monster a rigid airship can be. One is struck by his insistence in using the word "aviation" when dealing with airships, the connection between the two not being very clear. Why does not this gentleman mention the wonderful results obtained by Germany after numerous years of hard and methodical work on rigid construction? Has he heard of a Zeppelin airship breaking in two while manœuvring in the air? I really doubt it.

British airship designers are now meeting the cost of over-speeding increase in size before they have gathered sufficient data to work upon. The accident of R 38 seems to have been foreseen by German Zeppelin engineers. A few days before the catastrophe one of them, in Paris at the time, predicted that the ship would break in her middle, and also indicated under what circumstances the break would occur. This would tend to indicate that the weakness of R 38, unrealised by her designers, was quite evident to the Zeppelin people.

The hard lesson we have just had should brace us for a further long series of tests guided by the following motto: "Method and patience." I entirely endorse the author's idea about using our old hulls for structural tests on a large scale; this would certainly prove very interesting and supply our constructors with valuable information.

Meanwhile, why not turn to Germany, who, where rigid airships are considered, is undoubtedly the father of us all? A glance at the Nordstern, now housed near Paris, should serve to convert the most sceptical.

R. COLLINS.

Paris, September 7th.

### THE PROSPECTS OF YOUNG ENGINEERS.

SIR,—Having read in your issue of the 2nd inst. a letter by "Echo," on parents putting their sons to learn the profession of civil engineering, not knowing what the chances are of employment, to say nothing of success, I should like to give them the benefit of my experience, which, I believe, is that of not a few but many.

I am nearing forty years of age. I had a good general training and some experience afterwards in England. I have risked malaria, blackwater fever and sudden death in Africa and the East, and returned to England two and a-half years ago, since when I have had seven months' employment, and I believe I have been lucky to get that under present conditions.

I can show very good papers. I have had a great deal of experience, and responsibilities very few men in England get before fifty years of age.

Time is going on; I have a son to educate and start in life, and we have to live. Failing employment as a civil engineer, I have thought of many means during the past two years of making a living, and have even contemplated taking a public-house as a sure means of earning a steady livelihood.

May parents without means, who may read this, think before putting their sons to learn a profession for which there is already a greater supply than demand.

L. S. D.

Whitehaven, September 6th.

# A Seven-Day Journal.

## Shipbuilding Employers' Federation Chairman.

THE announcement that the chairmanship of the Shipbuilding Employers' Federation has been accepted by Lieutenant-Colonel James Lithgow has been well received by the industry. Colonel Lithgow is both by experience and temperament admirably fitted to assume this responsible position. He has a businesslike way of dealing with the complex questions which arise in connection with labour, having served both on the Clyde district board and the central organisation, and being quite familiar therefore with the various aspects of shipyard labour problems. The new senior Vice-president of the Federation is Mr. Leonard Ropner, of the well-known Stockton firm, while for the junior Vice-president choice has been made of Mr. Grant Barclay, who hails from Dundee. In the trying times through which the shipbuilding industry is passing it is very desirable that the chief officers of the Federation should be strong men of affairs.

## Mr. Churchward's Retirement.

A FAMILIAR figure will be missing from railway engineering circles when Mr. C. J. Churchward, the chief mechanical engineer of the Great Western Railway, relinquishes the reins at Swindon at the end of the present year. He has been associated with the Great Western Railway for over fifty years, having joined the staff of that company when it took over the South Devon and Cornwall Railway in the year 1870. It was eleven years later that Mr. Churchward first came into prominence on his appointment as assistant manager of the carriage and wagon works, and it was not until the early 'nineties that he assumed the position of chief mechanical engineer. Since he has been responsible for locomotive developments some notable work has been done at Swindon, and fine performances stand to the credit of locomotives designed by him. Under his direction, too, the Swindon works assumed considerable importance as a war factory. Mr. Churchward is to be succeeded by his chief assistant, Mr. C. B. Collett. It is a choice which will be generally approved.

## Coal Output.

DISAPPOINTMENT has been caused by the failure of the coal mining industry to keep up the satisfactory series of increases which were recorded until a very recent date. The official figures for the week ended August 27th were 4,102,300 tons, which compares with 4,327,900 tons for the previous week, and with 4,536,600 for the week ended August 13th. As compared with the corresponding week of last year, there was a falling off in the last week of the series quoted of nearly half a million tons. There was a decline in output in all the coal mining areas with the exception of Scotland, where an increase for the week ended August 27th of 19,000 tons was recorded. Later returns will be scanned with some anxiety in view of the need of increasing the output of coal. In some quarters apprehension—ill-founded, it is hoped—has been expressed in connection with the wages situation.

## Workman Clark Rumours.

THE story which has been in circulation as to the acquisition of the Workman Clark yard by a strong combine in which Lord Pirrie was interested has now been categorically denied. For a time all that could be said was that there was no official confirmation of the rumours, which on the surface were not out of keeping with expectations. Mr. Alfred Workman and Sir E. Mackay Edgar have now, however, lent their names to a definite announcement that there is no truth in the rumour that the Northumberland Shipbuilding Company has sold its interest in Workman Clark, and that indeed no negotiations with that object have ever been opened. The policy of the company, it is added, is to extend its holdings, a recent demonstration of which was the purchase of the Blythswood Shipbuilding Company.

## Aeronautical Engineers.

MUCH interest has been aroused by the steps which are being taken by the Royal Aeronautical Society to improve the status of the engineers engaged in the branch of the profession which the Society represents. With this object the Council is putting into force more stringent tests for those who desire to attain the status of Fellows or Associate Fellows of the Society, which may be taken to correspond to the membership and associate membership classes of the leading engineering institutions. It has, therefore, been decreed that to become an Associate Fellow a candidate must hold an engineering degree of a recognised University, or must have taken the course in aeronautics either at the Imperial College or Cambridge University. An alternative test will be the holding of the engineering diploma of certain technical schools and colleges. In addition, it will be necessary for an applicant to satisfy the Council of the Royal Aeronautical Society that he has had at least two years' practical experience in aeronautical engineering. For those who cannot produce the necessary diplomas the Society is itself providing an examination test of a sufficiently stringent character.

## Sir Philip Dawson, M.P.

BY his election in the three-cornered contest at West Lewisham Sir Philip Dawson has been added to the select band of men who stand for scientific and engineering interests in the House of Commons. The congratulations of the engineering profession will go out to Sir Philip, who has emerged successfully from a contest in which personalities were imported into the struggle to an unnecessary and in many respects unpleasant degree. A ready speaker and a well-informed man on many subjects, Sir Philip is likely to give a good account of himself in the House of Commons.

## The Amphibious Tank.

IT was an accident during a test of one of the new tanks on the Thames which gave the public a hint as to what is going on behind the scenes to develop the tank into a more efficient engine of war. The new tank, which is intended to propel itself through water as well as over difficult land, and of which several have been built at Woolwich, had given a good performance in the limited area of a pond at the Arsenal. Put to a more severe test on the Thames, the tank appears to have developed a leak and sunk into the mud in one of the reaches near Woolwich. She fortunately stranded in a situation which presented no special difficulties in the way of salvage operations, which were put in hand without delay. It is understood that the sinking of the amphibian was a mere accident, and is not a reflection on the principles underlying the design. The experiments will, of course, continue, and, indeed, it is an open secret that various types of tank for land use are being put through searching tests.

## First International Air Congress.

AN important gathering—the first really international air congress—will be held in Paris in November, and will extend over about ten days from the middle of that month. The Conference is being held under the patronage of the French Under-Secretary for Air, and will be participated in by all the French Associations connected with air transport. It is hoped to secure the attendance of the leading British experts. The subjects to be discussed will range over a wide area and should throw light on some obscure points, and perhaps enable some disputed questions of an international character to be settled.

## New Chairs at Glasgow.

IT will be recalled that as the outcome of steps taken by the Institution of Engineers and Shipbuilders in Scotland to commemorate the centenary of James Watt in a fitting manner, it was decided to raise a fund to provide new facilities for the training of engineering students at Glasgow University. The fund, which has just been closed, amounts to the substantial sum of £30,234. As the outcome of consultation with the University authorities, it has been decided to convert two of the existing lectureships into Chairs. Next month, therefore, appointments will be made to the James Watt Professorship of the Theory and Practice of Heat Engines and the James Watt Professorship of Electrical Engineering.

## Supplies of Radium.

IT is interesting to learn that as the outcome of an agreement between a British corporation and the Czecho-Slovak Government, the British company is likely to become the largest actual and potential owner of radium in the world. The agreement which has been entered into provides for the new company handling for a period of fifteen years the whole of the radium produced at the Joachimsthal mines. No radium will be sold, the intenton being that this rare mineral shall be hired out for research and medical work.

## Clearing the Seas.

IT is good news to all engaged in sea service that the work of clearing the Heligoland Bight—which had not been prosecuted with sufficient vigour at an earlier date—having now been completed by Germany, the North Sea may be regarded as being clear of moored mines. The Mediterranean is also practically clear, only a few small areas in which mines were laid now remaining to be swept, and good progress is also being made in rendering the Baltic safe for navigation. The Black Sea, however, constitutes a difficult problem. It is full of minefields, and no arrangement has yet been made to deal with the situation. The general work of sweeping the seas free of mines has been carried out by the International Mine Clearance Committee, on which thirty-three countries are represented. Under the direction of this Committee a vast amount of work has been done in a comparatively short period. It has to be borne in mind that it has not been only a question of clearing the seas, but of issuing instructions to navigators, and the fact that there have been so few marine casualties from striking mines—and these have mainly arisen from disobeying instructions—is the best proof of the efficiency with which the work has been performed.

## The Eight-Hour Day.

IT will have been noted that the chairman of the Irish Railways Arbitration Tribunal, in making his award, referred to the question of the eight-hour day on railways. Now that the Government subsidy has ceased, this is a problem which will have to be grappled with by railway managements, and it is understood that labour representatives who have made a study of the financial position of the companies are beginning to realise that the standardisation of hours of labour will have to go. On the Irish and Scotch railways the situation is quite clear. The chairman of the Arbitration Tribunal, to whom reference has been made definitely, states that the maintenance of the universal eight-hour day for all employees on Irish railways is not possible consistent with the solvency of these undertakings, or their restoration to the same efficiency to serve the needs of the public as before the period of Government control. What is true of the Irish railways applies certainly to Scottish railways, and in a great majority of instances to English railways. The whole situation will have to be reviewed.

## Artisans and their Craft.

THE criticism of Sir Richard Gregory that the average artisan takes less interest in science than the same class did a generation ago has aroused a good deal of comment, but is admitted to be true by those acquainted with the facts. There is no doubt that in the early days of mechanics' institutions the artisan took some pride in studying the scientific side of his craft. The explanation may be that workshop labour has tended with the passing years, and the introduction of new machinery, to become so monotonous as to kill all interest in it. The tendency is one to be deplored, as it is certain that with the spread of educational facilities and the greater amount of leisure of the worker arising from the shortening of the factory day, the artisan has more opportunities than ever before of acquiring a scientific knowledge of the industry in which he is engaged. How he can be induced to do so is a question with which many have grappled but to which nobody has yet succeeded in finding the answer.

## Railway Electrification.

MEMBERS of the Advisory Committee do not believe that any controversy will arise in connection with the proposals of the Ministry of Transport on the electrification of railways. The companies interested in the subject had a fairly strong representation on the Committee, and the recommendations which were made in the interim report, that future conversions of steam railways should be on the direct-current system, and that the standard of pressure at the sub-station bus-bars should be 1500 volts, have now been confirmed. As might have been expected, however, the question of allowing the Brighton Railway Company to remain in a state of splendid isolation with its single-phase alternating-current system has aroused criticism, but the Committee, having considered this subject in all its bearings, has come to the conclusion that for financial reasons it is not desirable to request the Brighton Company to revert to direct-current working. The electrification of the main line to Brighton and other towns will, therefore, be on a single-phase system, and the work of extension is to be put in hand almost immediately. It is probable that the first of the railways serving the London district which have until now relied on steam working to equip suburban routes for electrical operation will be the Great Eastern Railway, whose plans are practically completed. It may be taken for granted that with the exception of the Brighton Company, the management of which is very desirous of extending electrical working to its main line trains, there will be no attempt to deal with main line electrification at the present time.

# The Shipping and Engineering Exhibition.

No. II*.

## WATER-TUBE BOILERS.

ON the stand of Yarrow and Co., Limited, of Scotstoun, there are two exhibits of unusual interest to those who have followed the fortunes of the water-tube boiler from the early days of its inception. One of these exhibits is the actual boiler with which Mr. Yarrow made his first experiments and with which he demonstrated that straight-drowned tubes could be used in a water-tube boiler with complete satisfaction. This boiler is in practically the same condition as it was in some thirty-five years ago, when the experiments were made, except that it has since been galvanised, and it should interest any of those engineers who witnessed the original trials, as it is being shown with the casing removed. The other exhibit just referred to is a model of the latest type of Yarrow boiler, which embodies the new cylindrical form of water drum described in our issue of May 27th last. This model, of which we give an illustration in Fig. 23, p. 294, represents a boiler adapted for burning oil fuel and capable of developing 10,000 shaft horse-power, or evaporating about 125,000 lb. of water per hour and supplying steam superheated to a high temperature.

Superheating, it will be remembered, was originally adopted by Yarrows in the boilers for H.M.S. Archer and Attack, built in the year 1911, and the success obtained with superheating in those vessels was so marked that the firm decided that in all future destroyers it would fit superheaters. The Yarrow superheater, as originally fitted in the Archer and Attack, was of the double header type, the headers being specially designed forgings which were bored out from the solid bar, internal rings being formed where necessary for securing the diaphragms which divided the superheater longitudinally into three parts. As it was necessary to keep the diameter of these headers as small as possible, it was out of the question for a man to enter the header to examine and expand the superheater tubes, so a scheme was evolved by means of which the tubes could be examined and the ends expanded from the outside of the headers. Two longitudinal rows of holes of 2¼in. diameter were drilled through the walls of each of the headers, each row of these holes being opposite every alternate double athwartship row of superheater tubes. The ends of the tubes were so angled that the axes of the tubes on each two adjacent rows passed through the centre of the holes, thus enabling five tubes to be examined and expanded through one small hole.

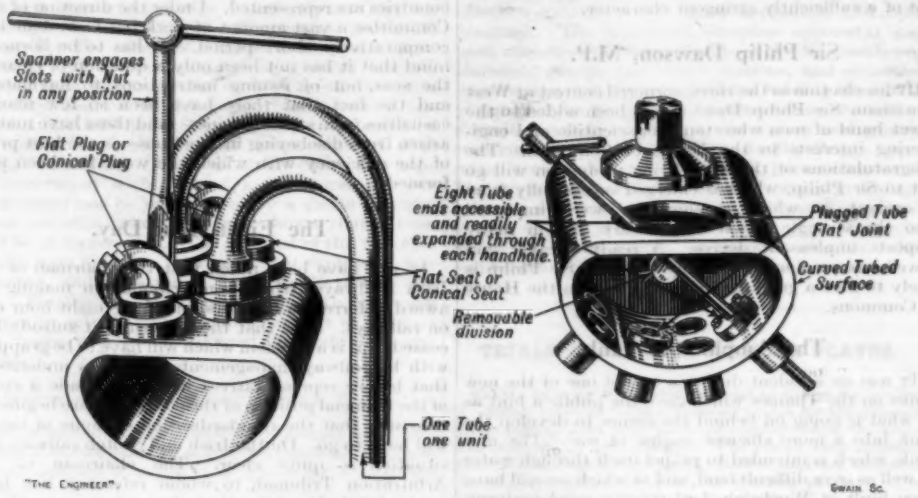

Spanner engages Slots with Nut in any position
Flat Plug or Conical Plug
Eight Tube ends accessible and readily expanded through each handhole
Flat Seat or Conical Seat
Removable division
Plugged Tube Flat Joint
Curved Tubed Surface
One Tube one unit
"THE ENGINEER"
GRAIN SC.

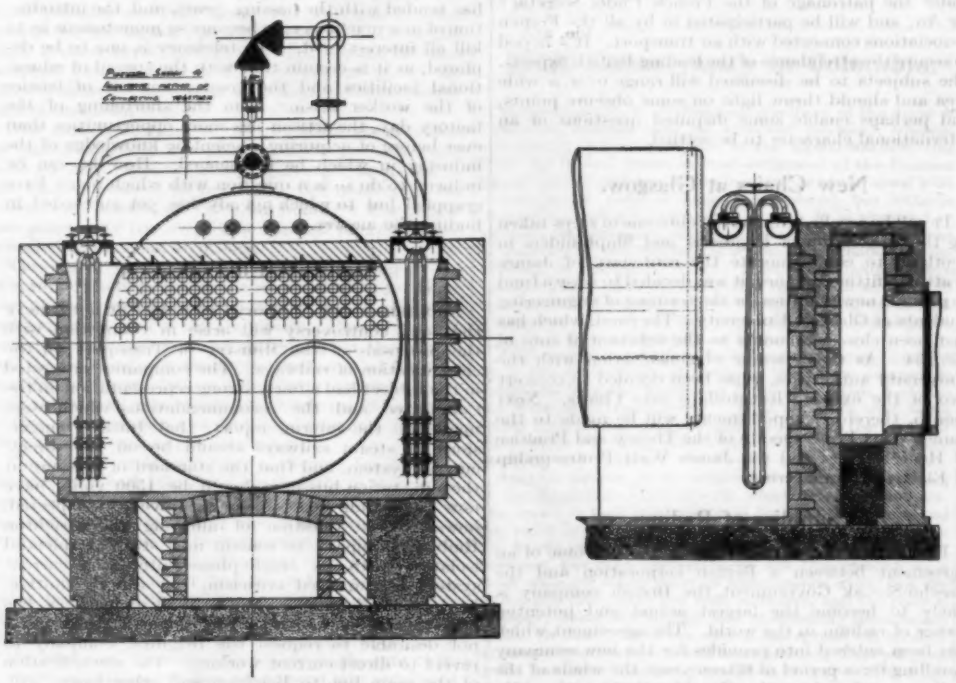
FIG. 12—HEADERS FOR DANKS' SUPERHEATERS

Each hole was fitted with a circular door and dog. In later boilers the double-header type has been abandoned and the single-header type adopted. It is this latter form of superheater which is embodied in the model, and as the space available permits of a large header, it is possible for a man to get inside for examining and expanding the tubes.

The superheater is divided into three sections in order to obtain the requisite velocity of steam through the tubes. The inside of the header is fitted with diaphragms and doors, all of which are so arranged that they can be easily removed when examination of the tubes is required. The pipe supplying saturated steam from the main steam drum is situated at the back of the boiler, and conveys steam into the first one-third section of the superheater, which is formed by the space outside a longitudinal diaphragm or trough and a cross diaphragm surrounding the trough and placed at one-third of the length of the superheater nest from the back. From this space it enters the upper portion of the U-shaped superheater tubes; it then flows towards the bent portion of the tube and down this group of tubes (on the side nearest the furnace) into the space formed by the inside of the longitudinal diaphragm or trough and a cross diaphragm placed inside the trough two-thirds along the nest of superheater tubes. The steam passes from the first one-third section of superheater to the second section by means of the trough referred to above. It then flows up the tubes on the furnace side of this section and down the tubes on the casing side into the space formed outside the longitudinal diaphragm or trough and between a cross diaphragm at the end of the nest, and the one referred to above for the first section. It next flows up the last and third section of the tubes on the casing side and down them on the furnace side into the remaining portion of the longitudinal diaphragm or trough, and finally flows out from the end of the trough into a space at the end of the header to which is attached the main stop valve.

A damper is placed on one side of the funnel, and the uptake is divided longitudinally by a diaphragm plate. The damper is fitted with a view to regulating the amount of superheat. Thus if it is closed the gases from the furnace will pass through the wide nest of generating tubes on the right and not through the narrow nest and the superheater. The extent of the superheat will be correspondingly reduced. On the other hand, if the maximum superheat for which the boiler is designed is required, the damper is opened and the gases flow equally through both sides of the boiler. When the damper is closed a certain amount of saturated steam will, of course, be formed in the generating tubes on the superheater side of the boiler.

The damper above referred to is air-cooled and for this purpose the damper spindle consists of a hollow tube in which are drilled several holes. The damper consists of two plates nearly joining each other at their peripheries. Around this periphery there are drilled a large number of small holes for the circulation of air. In order to minimise the risk of the damper becoming excessively hot, the air supply to it is taken, by means of a tube connected to the end of the hollow damper spindle, from the closed stokehold, which is, of course, under forced draught. The oil-burning system shown on the model is of the Yarrow patented type.



FIGS. 13 AND 14—DANKS' SINGLE AND DOUBLE HEADER SUPERHEATERS

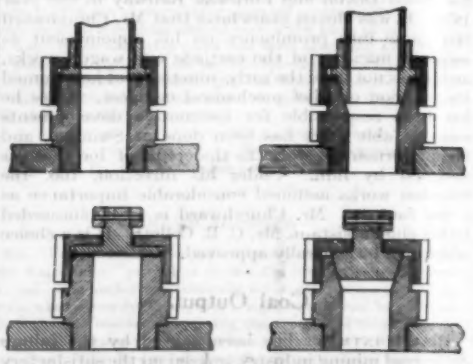


FIG. 15—TUBE UNIONS AND CAPS

The safety air-boxes are of the usual type, and the fittings have been specially designed to meet modern requirements.

## SUPERHEATERS.

Full-sized sections of two distinct types of superheater are being shown by H. and T. Danks (Netherton), Limited, of Netherton, Dudley. They are both made under Grantham's patents, and are of such a nature that they are readily adaptable to practically all standard classes of boiler.

The distinction between the two types of superheater is plainly shown in Fig. 12, from which it will be seen that the tubes are either expanded into the lower side of the header, or connected with the top by means of screwed unions. In either case the cross-sectional form of the header is the same, which, it is claimed, is superior to others in that the flat top surface permits a satisfactory hand-hole joint to be made, while the curved lower part, into which the tubes are expanded, is of a naturally strong form. At the same time the transition from the curved to the flat contour is made by a good wide radius that eliminates any weakness which might be caused by a sharp corner.

In the expanded tube form of superheater, of which a header is illustrated on the right of Fig. 12, and a complete example given in Fig. 13, the joint for the hand-hole is made on the flat surface of the header. The metal is faced on both sides, and both inner and outer covers are provided. The inner cover, together with its stud, is formed by a stamping, and has a spigot which fits the hole in the header and prevents any great escape of steam in the event of the shank breaking. The disposition of the tubes and the relative dimensions of the several parts are such that at least eight tubes can be expanded in place, through every hand-hole, without the use of special tools. This feature is, of course, of considerable advantage if one or more tubes happen to fail, as the length of time during which the superheater may have to be out of commission for the purpose of repairs is minimised. Fig. 12 shows the process of expanding a tube into its hole in the header, and also a tube with a temporary plug. The plugs are screwed internally to accommodate a long bolt so that they may be easily withdrawn when an opportunity occurs to renew the faulty tube. Where the space available

* No. I. appeared September 9th.

for the superheater is narrow it is arranged as shown in Fig. 13, and a single header is used for each group of tubes. The header is partitioned off half-way along its length, by means of a division piece, which is made in three pieces and can be wedged in place through one of the hand-holes. The superheating tubes are then bent into U's and their opposite ends expanded into the two parts of the header. Where there is ample room, two headers can, of course, be used, and the opposite ends of the U tubes expanded into the separate headers. With this arrangement as much as 450 square feet of superheating surface can be added to a 30ft. by 8ft. Lancashire boiler without extending the flue dimensions by beyond a few inches.

In the second type of superheater, a section of which is shown on the left of Fig. 12, the tubes are connected with the headers by means of unions. Each of the tubes is entirely independent of any other tube, a distinct advantage over a great many sectional types, where, if one tube fails, all the other tubes comprising the section have to be replaced. The joint at each end of a tube is made independently, which overcomes the difficulties experienced, and the skill required, in fixing the tubes in those types where pressure has to be exerted centrally between the ends of the tubes. Every tube is interchangeable, so that the quantity of tubes which have to be stocked for replacements is reduced to a minimum. Two types of union joint are provided, one of which has a conical seat, and the other a flat seating for use in connection with a jointing material. Fig. 15 shows the two alternative unions and the method of capping off if the tubes happen to fail, while Fig. 14 gives a section through one of these superheaters and shows how the tubes are made interchangeable.




FIG. 18—THE RECORD ENGINE

### THE RECORD ENGINE.

The Record Engineering Company, Limited, of Tutbury, Burton-on-Trent, is showing four internal combustion engines embodying the broad principles of design described in our issue of March 11th last. Since then, however, several details have been altered, and the twin cylinders are now arranged transversely, as shown in Fig. 18, instead of longitudinally to the crank shaft. One of the good features of the design, it will be noticed, is the use of a crosshead guide, which relieves the pistons of all side pressure. Again, the valve is of the ordinary piston type and is driven by means of an excentric fixed to the crank shaft. Thus the valve and gear is a smooth-working piece of mechanism, which is also silent in operation.

Fig. 25, page 294, shows a ship's emergency lighting set consisting of a Record paraffin engine coupled to a 16-kilowatt Sunderland Forge Company's dynamo. The engine is of the two-crank type, easily capable of developing the power required at a speed of 650 revolutions per minute. The cylinder heads are removable, this being the standard practice of the makers for all sizes of engines. Fig. 26, page 294, shows a four-crank 20 horse-power motor boat paraffin engine of similar construction. This engine is also fitted with forced lubrication throughout. A small electric lighting set is shown running on town gas at the exhibition. These sets are made for petrol, paraffin, town or suction gas, and in sizes from 1½ brake horse-power upwards. A small engine is also exhibited with the cylinders in section, by means of which the operation of the engine may be easily followed. We understand that these engines are now made in standard sizes from 1½ brake horse-power to 250 brake horse-power.

The line drawing, Fig. 18, shows clearly the new arrangement of the engine, and should be compared with Fig. 2, p. 271, of our last volume. A is the pump piston, which is used to draw in and slightly compress the mixture—whether petrol, paraffin or coal gas—and deliver it to the working cylinders B B. Formed with the pump piston A is a crosshead guide, and the piston C which carries the gudgeon pin D. This crosshead guide piston works in the cylinder C, and thus relieves the pump piston A and working pistons B B of any side pressure brought about by the angularity of the connecting-rod. The crosshead guide is not subjected to any great heat or gas pressure, and consequently works under conditions very similar to the crosshead of a steam engine. The distribution of the mixture to and from the pump cylinder A is controlled by means of the piston valve E, which is operated directly from the crank shaft by means of an excentric, as shown. The top side only of the pump piston A is used to compress the mixture, the pump being single-acting. Two working pistons B B placed side by side and attached to the top of the pump piston A reciprocate in the two parallel cylinders. The cylinders have a common combustion chamber F. Around one of the working cylinders there is a ring of ports G, through which the exhaust takes place, while another ring of ports H in the other cylinder provides for the admission of the mixture.

The sequence of events is as follows :—The mixture is drawn in and delivered by the pump piston A to the belt around inlet ports at H. At the top of the stroke the compressed charge is fired as usual, the two working pistons B B travel downwards, and when nearing the end of the stroke the exhaust ports at G are first uncovered and the burnt gases are allowed to escape. Immediately afterwards the ring of inlet ports H is uncovered and the compressed mixture rushes in and drives out the remaining burnt gases. The pistons now rise again and compress the mixture, when it is fired in the usual way.

Another noteworthy fitting for petrol engines also exhibited by this company is the S.A. impulse starter shown in Fig. 16. This starter can be easily fitted to any standard magneto, and does not occupy any more space than the ordinary magneto coupling. The principle upon which the mechanism operates is as follows :—The magneto armature is temporarily arrested by the action of pulling a pawl into engagement with the armature plate, which is attached to the armature spindle. The action of arresting the rotation of the armature causes the spiral spring inside the starter to be wound up as the spindle is turned, and energy is stored in the spring until such time as the cam on the cam casing disengages the pawl from the armature plate. As soon as this disengagement takes place the spring imparts a rapid impulse to the magneto armature which is equal, the makers say, to revolving the armature at 500 revolutions per minute, and an intense spark is produced at the plug in the cylinder which is on the firing stroke. The spiral spring is so arranged that after the impulse has taken place the armature plate and cam casing are spring-locked, so that the ordinary timing of the engine and magneto is maintained and the starting device acts as an ordinary coupling. The pawl-operating mechanism is so arranged that immediately the engine revolves under its own power, the pawl is thrown out of operation, and comes under the influence of the magnets of the magneto, which keep it in position until such time as it is operated by the pull button.

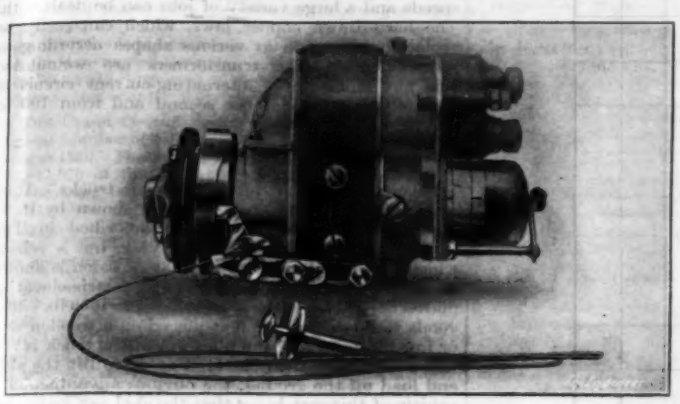


FIG. 16—IMPULSE STARTER FOR PETROL ENGINE

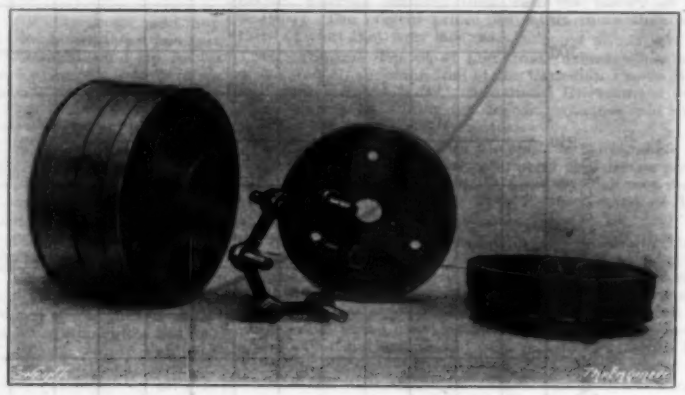


FIG. 17—FLEXIBLE COUPLING

### A NEW COUPLING.

In addition to a good collection of searchlights and searchlight mirrors of various types, the London Electric Firm, of Croydon, is showing a new flexible coupling which is illustrated in Fig. 17. The two parts of the coupling, which are keyed in the usual way to the ends of the shafts to be connected together, are composed of more or less orthodox flanges which are held together by pins attached to a laminated link system as shown in the centre of the illustration, and consisting of steel stampings interleaved together. The pins, which fit in the holes of one part of the coupling, project in the opposite direction to those which fit into the holes of the other part. When the coupling is assembled the nuts which hold the pins and which clamp the laminations together come within the openings in the flanges. Obviously, the flexibility of the links will compensate for any lack of alignment.

### ELECTRIC WINCHES.

Electric winches which are claimed to show an enormous saving in fuel consumption and in the cost of maintenance as compared with the fuel consumption and cost of upkeep of steam winches are shown on the stand of Laurence, Scott and Co., Limited, of Norwich. The company's new 4-ton worm-geared deck winch is claimed to offer important advantages, such as high efficiency and small dimensions. All the working parts are enclosed and completely protected from sea water and the effects of bad weather. The speed of working is equal to that of a steam winch. A totally enclosed and water-tight electric motor drives the barrels and bollards through worm gearing which is enclosed in a substantial water-tight and oil-tight case. The worm wheel is composed of phosphor bronze and the worm of oil-hardened steel. A master controller fixed on top of the motor is enclosed in a water-tight cast iron case and can easily be operated with one hand. The automatic brake is also totally enclosed, but it can easily be adjusted. By means of a release lever at the left of the operator it is possible to lower heavy and medium loads with perfect ease and without using power. The foot brake is a substantial Ferodo-lined band brake, which acts upon the barrel and is interlocked with the controller. The control wheel, hand release and foot brake are all within easy reach of the operator and can all be operated at the same time. No matter how great the load that is lowered may be, it is impossible, the makers claim, for the speed to rise above the safe limit. Fig. 19 gives the speed load curve. The speed change is entirely automatic. A heavy load of, say, 4 tons is lifted at the slow speed of 75ft. per minute, and the normal medium loads of, say, 1 ton at 200ft. per minute. These conditions are brought about by the makers' patented load discriminator, which automatically raises the speed at half load, and thus overcomes the chief objection to the ordinary electric winches, namely, the comparatively small increase of speed between full load and half load. The speed at "light hook" load is four times that at which the winch works at full load, but a slow speed can be

obtained at light load by operating the foot brake, which automatically keeps the winch operating on the first control step. Rapid lowering with light loads can be obtained by putting the control wheel into the "full over" position. Excessive speeds are prevented at all loads by speed limiting shunt coils and a mechanical centrifugal brake. Only motors of the highest class, the makers explain, are suitable for dock work. Electric winches must not only be absolutely foolproof, but also rogue-proof, for it has been found that where exceptionally rough labourers have discovered that by working the winches in a certain way they could blow the fuses they have done so deliberately in order to leave work and get under shelter during rough weather. To meet this condition Laurence, Scott and Co. have evolved a hand-operated master controller which is fixed on top of the motor and which works a contactor controller stowed away, and it is therefore impossible to operate the winch in a manner that will cause an excessive current to put the machine out of action, for the speed at which the resistances are cut out cannot be increased to a dangerous extent by any manipulation of the hand wheel. Other exhibits on the stand are electrical steering gear and crane motors.

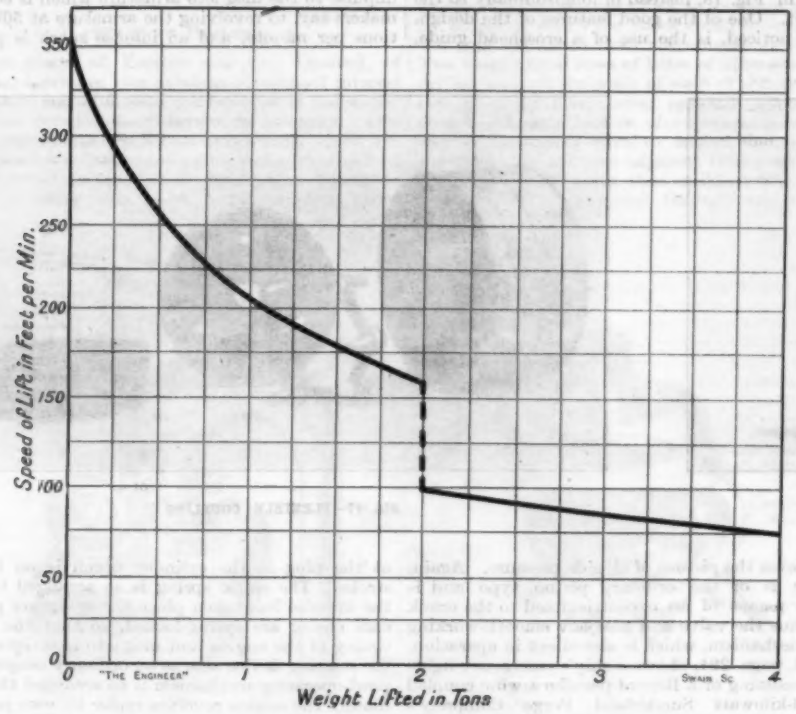



FIG. 19—SPEED-LOAD CURVE FOR LAURENCE, SCOTT ELECTRIC WINCH

### Electric Welding Equipments.

Perhaps there has never been a better display at any previous exhibition of electric welding equipments. Arc and resistance welding outfits are shown by several firms which specialise in this class of business, and those who desire to acquire up-to-date information concerning this system of welding ought not to miss the opportunity which the exhibition provides. Unfortunately, we are not yet in a position to illustrate and describe all the welding equipments, but we hope to deal with them later. For the present we shall consider the exhibits of the Premier Electric Welding Company. Among other things, the company is showing two complete arc welding plants of the single operator type, one driven by an engine—see Fig. 24, page 294—and the other by a motor, as shown in the drawing, Fig. 20. In the case of the engine-driven set the generator is rated at 4.4 kilowatts and the engine at 10 horse-power. The generator is provided with a separate exciter and a reactance for controlling the welding current. There is also a switchboard with the usual fittings.

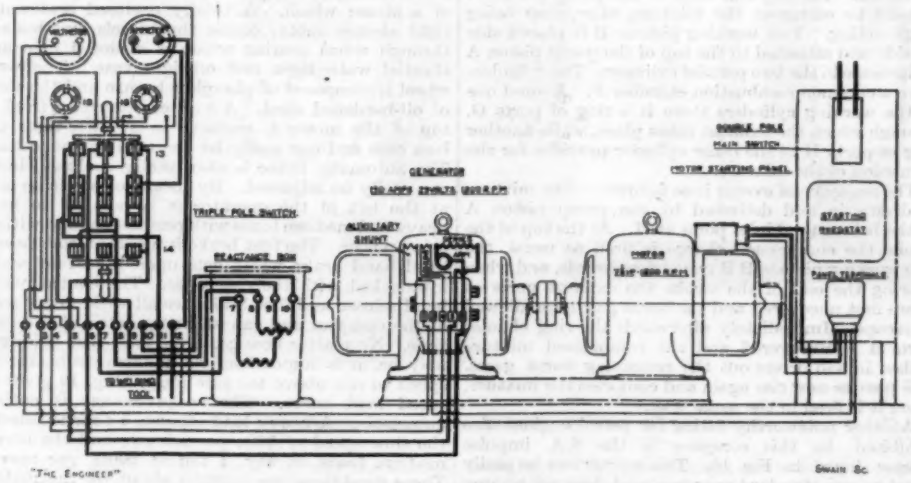



FIG. 20—PREMIER MOTOR-DRIVEN ARC WELDING PLANT

The motor generator welding set as shown in Fig. 20 is very similar to the engine-driven unit, with the exception, of course, that the engine is replaced by a motor which is designed to develop 7½ horse-power. From the diagram it will be perceived that the generator has a main shunt, auxiliary shunt, and series windings. When the main switch on the switchboard is closed on to the upper contacts as shown in the drawing the reactance coils shown in the box are connected in parallel, whilst, when the switch is closed on to the lower contacts, the coils are connected in series. Regulators are connected in the main and auxiliary shunt circuits. The firm is also exhibiting some samples of its electrodes for welding mild steel, wrought iron, cast iron, manganese steel, &c. One of the company's latest types of water-cooled spot welding machines is shown. By means of a regulator the machine can be made to work at various welding speeds and a large variety of jobs can be dealt with. The hard-drawn copper jaws, which can easily be replaced, are made in various shapes according to requirements. The transformers are wound to suit any single-phase alternating-current circuit of from 40 to 60 cycles per second and from 100 to 500 volts.

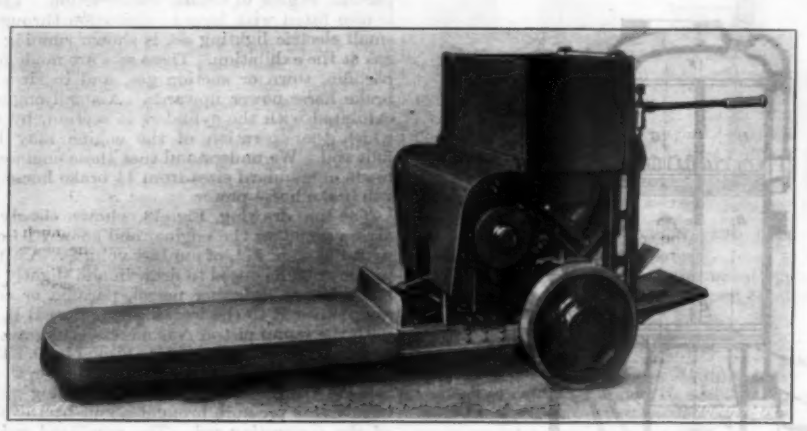


FIG. 21—ELEVATING PLATFORM TRUCK

### Electric Trucks.

Several firms are exhibiting electric trucks. Automatic trucks of various types are shown by H. C. Slingsby. Most of them were described in THE ENGINEER of April 15th of this year, but a vehicle which was not dealt with on that occasion is shown in Fig. 21. This is one of the firm's electric elevating platform trucks with a capacity of 4000 lb. The goods to be carried are first placed on a wooden skid or low platform and the platform of the truck is run underneath and then elevated so as to lift the skid and load off the ground, the obvious advantage of a vehicle of this sort being that the skid can be loaded while the truck is delivering goods elsewhere. The vehicle is fitted with four-wheel steering gear, which is operated by a steering lever working vertically or horizontally. The steering levers are fitted with renewable bushings and hardened steel bearing pins are provided throughout. Power for working the truck is derived from a battery contained in a box placed over the driving wheels, an arrangement which enables the truck to exert a good tractive effort. From the motor the power is transmitted to a full floating axle through gearing which is totally enclosed. The platform lifting mechanism is operated by a separate motor, which is interchangeable with the driving motor, and the motor lifts the platform 3½in. by means of a steel worm. When the platform is fully raised the load is sustained on separate supports which take the entire strain off the lifting mechanism. These independent supports are said greatly to add to the life of the truck, especially when it is operated over more or less rough ground. A drum type controller having large contact segments gives three speeds in either direction, and a foot pedal operates a quick-acting shoe brake and also acts as a safety device by closing and opening the circuit, thus making it impossible for the machine to be moved when the operator is not standing on the driving platform. When these trucks have to be operated on rough or uneven roads 16in. rubber tires are fitted.

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IT is quite like old times to read a railway advertisement announcing "luxurious rolling stock, smooth running and a dustless road." This is what is being done—and the claims can be justified—by the Midland and Great Northern Joint line. The future of this joint property is, by the by, interesting. It is very much within the area of the Eastern, North-Eastern and East Scottish group, but the Midland company is half owner of the greater portion, a third owner of 22 miles, and owns the connecting line between its own system at Saxby and Bourne on the joint line. The Midland is, of course, in the opposite camp.

THE amount of imported coal carried during June made the results for that month, when compared with June, 1920, slightly better than those of May when compared with May, 1920. The tonnage of general merchandise carried in June was 40.34 per cent. less than in 1920, and the ton-mileage 41.04 per cent. less; coal, coke and patent fuel was 88.62 per cent. less in tonnage and 87.99 per cent. less in ton-miles, and other minerals 67.61 per cent. less in tonnage and 70.27 per cent. in ton-miles. Freight traffic, on the whole, was 74 per cent. less in tonnage and 69.21 per cent. less in ton-miles. Freight train mileage was 59.4 per cent. less.

## Railway Matters.

THE Nydquist Holm Works at Trollhaettan, according to the Gothenburg paper *Ny Tid*, are ready to make a first delivery of three railway engines to Russia. At the present time there are forty more engines under construction, a number which constitutes a record for the Swedish industry.

IN order to get them carried out more cheaply, many of the United States railways deferred their wagon repairs until after July 1st, on which date the new wage rates were to come into operation. One consequence was that on the date named the number of cars under or awaiting repairs was 15.4 per cent. of the whole. The corresponding figure in this country is about 5 per cent.

THE Grand Central terminal, New York, handled the largest number of railway passengers into and out of that city in 1920. The figure was 36,937,120, as compared with 35,947,570 at the Pennsylvania terminal and 33,968,090 at the Long Island Company's Flatbush-avenue station. The last-named figure is nearly 6,000,000, or 23 per cent. more than the corresponding figures for 1919. A remarkable feature about the station to which it relates is that the accommodation consists only of two tracks.

RECENTLY, for a "Pageant of Progress" in Chicago, the locomotive, De Witt Clinton—which hauled the first passenger train from Albany to Schenectady on August 9th, 1831—and engine No. 999, which made the record run with the "Empire State" express, were lent by the New York Central Railroad. The tender of the latter was re-painted and decorated to appear as it was at the height of its triumph in 1893. The Chicago and North-Western Company sent its Pioneer, which drew the first train out of Chicago in 1848.

YET another pre-war passenger traffic institution has been revived. This is what is known as the "guaranteed excursion," and is, as its name implies, a special train run under a guarantee of a certain number of passengers. The fares are no less than those by other excursions, but the promoters get a discount in return for their guarantee. The railway advertises the excursions and gets business by that means and is ensured a full paying train-load. The size of a party desiring reduced fares has now been diminished from thirty to twelve.

THE Tasmanian Government, which last year purchased two second-hand 3ft. 6in. gauge locomotives from the South Australian Government at £12,500 each, has now acquired four more at £10,500 each, less £100 each engine for the Westinghouse brake gear, the vacuum brake being used in the island State. The Tasmanian Railways are, it is officially stated, still many engines short of requirements. Ten are on order with a private firm, and when they are delivered it is quite probable that the Department will place a further order. During the financial year just ended traffic returns on the Tasmanian lines revealed an increase of 100,000 tons in goods tonnage, and a rise of 100,000 train miles.

ALTHOUGH, as stated in this column of our issue of August 26th, the Railway Clearing House has since April 1st been working on the divisions of through passenger and goods traffic, the weekly railway traffic returns have not been resumed and are not likely to appear until the opening of next year. The semi-official explanation for this is that "in pre-war days the flow of traffic was fairly well known and the companies were in a position to estimate with a fair degree of accuracy the amount which could be fairly claimed as their proportion of receipts from this source, but the war conditions have so upset the normal flow of traffic that no company can attempt to say what its revenue from through traffic will be." The real cause for the postponement, it may be suggested, is that the companies hope by the end of the year to have made good progress with the grouping scheme. Whenever the returns begin they will be of little value until the corresponding figures for the preceding year are available.

ACCORDING to the Board of Trade returns, the value of the railway material exported during the six months ended June 30th last was as follows, the corresponding figures for 1920 and 1919 being added in brackets:—Locomotives, £3,459,385 (£2,377,890, £433,538); rails, £1,793,057 (£916,721, £839,481); carriages, £815,260 (£677,175, £181,362); wagons, £3,057,041 (£2,737,934, £486,700); wheels and axles, £1,115,857 (£961,355, £223,549); tires and axles, £806,866 (£636,815, £453,402); chairs and metal sleepers, £735,862 (£314,244, £126,334); miscellaneous permanent way, £1,467,742 (£1,135,674, £420,315); total permanent way material, £6,070,950 (£4,010,874, £1,407,643). The weight of the rails exported was 81,319 tons (49,783 tons, 52,104 tons), and of the chairs and metal sleepers, 29,656 tons (14,981 tons, 7770 tons). During June, locomotives to the value of £185,327 were shipped to India, of £45,320 to the Straits Settlements, of £40,440 to South Africa, and of £21,000 to the Argentine.

MATTERS with the Grand Trunk Railway of Canada would appear to have gone from bad to worse. The Commission over which Sir Henry Drayton presided, the two other members being Sir William Acworth and Mr. A. H. Smith, of the New York Central, recommended, in 1917, that it be taken over, along with the Canadian Northern, by the Government, and this action, being rendered the more necessary by war conditions, was taken. An arbitration board composed of Sir Thomas White, Mr. W. H. Taft—the United States ex-President, and now Chief Justice of the Supreme Court—and Sir Walter Cassels had to decide as to the value of the property. According to cable advices received on the 8th instant, Sir Thomas White and Sir Walter Cassels have reported that having regard to the continuing heavy deficits, together with the necessity for providing for deferred and extraordinary maintenance and capital construction, and heavy liabilities in respect of securities for the Grand Trunk Pacific, the Grand Trunk, but for the support of the Government, must have been forced into a receivership. Its preference and common stocks, of the amount of £37,000,000, were, therefore, of no value. Mr. Taft dissented from this view, and not only said that the stocks had value, but placed the value slightly higher than the maximum fixed by the Act. An appeal to the Privy Council is to be made.

## Notes and Memoranda.

THE Swedish Government, we learn, has granted a loan of 5000 kr. to an engineer for the manufacture of peat bricks for building purposes. These bricks are expected to replace imported goods for isolating and packing walls and floors, especially of country houses, and it is estimated that by their use building costs will be reduced by 60 per cent.

A NEW Japanese process by which magnetic sand may be converted into pig iron and thence into steel has just been made public by Mr. Goro Matsukata and Dr. Asobu Naito. The sand iron is combined with coke to form ferro-coke, from which iron can easily be taken. Japan has little or no iron in any form which may be easily mined, but magnetic sand is abundant throughout the empire.

THE official report on the explosion of a cast iron steam chest on the trawler Canosain shows that the design of the chest was defective in that there were no ribs to connect the flange with the body of the chest. The result was that a crack developed in the casting and ultimately led to complete failure, with the result that a man was killed. The Canosain was an ex-German vessel built at Geestemunde.

IN connection with the electrification of the Midi Railway, the Swiss firm, Brown, Boveri et Cie. has recently secured a contract for the complete equipment of the five sub-stations of Pau, Lourdes, Tarbes, Montrejeau and Lannemezan with mercury arc rectifiers. The contract, which is a very exceptional one, comprises in all sixteen 1200-kilowatt rectifier sets to operate at a direct-current pressure of 1575 volts. Each set consists of a single main transformer supplying two high-tension rectifiers in parallel. The primary supply will be three-phase at 60,000 volts and a periodicity of 50 cycles. The overload capacity for which the rectifiers are being designed is 50 per cent. for two hours and 200 per cent. for five minutes. The progress made during recent years with this class of plant is very marked, something like 100 individual equipments being either installed or in hand.

THE leakage of cooling water charged with impurities through the innumerable joints of a surface condenser is a trouble in steam plant operation. Condensed steam should provide good feed water, practically free from dissolved salts; yet the leakage of relatively small quantities of raw water into the condenser may so increase its content in scale-forming or corrosive substances as to render it unfit for use in the boilers. It is therefore most important to detect and, if possible, to measure the leakage in every condenser in a plant. An article by Mr. W. E. Caldwell, appearing in *Power* of August 9th, describes an ingenious method of obtaining a continuous graphic record of the leakage, by measuring and recording the electrical conductivity of the condensate, for the conductivity of the condensate may be assumed without serious error to be directly proportional to the amount of raw water that has been mixed with it.

IN his paper before the Institution of Civil Engineers, dealing with "Internal Combustion Engines with Large Cylinders," Sir James McKechnie stated that so completely has the point of view changed regarding oil engines that owners are now seeking to investigate the possibilities of marine internal combustion engines of much greater power than hitherto have been fitted in the mercantile marine, and that builders and designers are being encouraged to prepare designs for the largest and speediest vessels to be constructed. Also, that orders for motor ships in some cases are being carried on while similar steamships have been cancelled. Regarding cylinder sizes, Sir James said that marine oil engines up to 30in. diameter are now running, and that there seemed no reason to assume that they cannot be made with larger cylinders. He referred to a two-cycle double-acting Diesel engine with one cylinder 30in. diameter by 36in. stroke built at the Vickers plant having developed 1042 brake horse-power for seventy-three hours at 141 revolutions per minute in 1913.

ACCORDING to *Power*, a Bill has been prepared by an American legislator with a view to making it unlawful for persons to enter boilers whilst they are under pressure. Section 1 of the Bill reads:—"It shall be unlawful for any railroad company or any person, firm or corporation, using steam boilers, to command, order or permit by themselves or their agents any of their employees to enter any steam boiler, fire-box, or smoke chamber thereto, for the purpose of repairing or cleaning the same or for any other purpose *when the same is under steam pressure*." This, it seems, is the actual text, copied exactly as it was printed, except that the last seven words have been put in italics. There are five more sections, which are designed to set up further restrictions against ordering a man to enter a boiler under pressure. The intentions of the individual who prepared the Bill seem to have been good, and, indeed, mistakes will happen; but our contemporary suggests that whatever becomes of this Bill, it is to be hoped that no man will ever try to get inside of a boiler without at least reducing the steam pressure to, say, about 50 lb.!

A PAPER issued by the Bureau of Standards at Washington gives an account of the tests on six hollow cylindrical steel castings manufactured by the centrifugal process. The castings were 6ft. long and of diameters up to 18in., with holes of various diameters through them, and they were made with the mould revolving about the axis at a speed not specified. Samples of the metal taken from different parts of the complete castings were tested for hardness, tensile strength, soundness, structure, and density, both in the condition as cast and after heat treatments of various kinds. It was found that there was a slight segregation of carbon, phosphorus, sulphur, nickel, and copper in the radial direction, but none of manganese and silicon. Small blow-holes were evident in the inner $^1/_{16}$in. of the castings. After heat treatment several of the castings showed mechanical strength equal to forged materials of the same composition, and satisfied the ordnance requirements for gun forgings. Microscopic examination showed no hard spots, flaws, or other defects outside the layer $^1/_{16}$in. thick at the inner surface, and the process appears to be one of great promise.

## Miscellanea.

THE Victorian Electricity Commissioners are contracting for the purchase, from the Zeitz Company, of Germany, of briquetting plant for use at the brown coal mines at Morwell. The cost is stated to be £110,000.

WE hear that the cost of stainless steel golf clubs has lately been brought within the reach of the average player, whereas formerly they were the luxury of the wealthy. The present prices are rather more than one-third of what they were last year.

AN extensive deposit of high-grade asbestos has been discovered on the main line of the Canadian Pacific Railway near Kamloops, B.C. Provincial Government engineers are now examining the deposit, which is said to be equal to the best Quebec asbestos.

ACCORDING to a report on the trade of Syria, there are some schemes under discussion for obtaining electric power from streams in the Lebanon. A beginning has been made with one such scheme at the Nahr Ibrahim, north of Beyrout, but it has made little progress.

OWNERS of iron mines in Spain are continuing their campaign against the proposal to place an export tax on iron ore. They affirm that foreign countries will be able to do without Spanish ore and that this abstention would involve the closing of a large number of mines. Such an event would entail considerable hardship, since the home metallurgical industry is not in a position to absorb the present production of the country.

THE South Australian Government has accepted a local tender for the construction of a new pier at Port Lincoln, 156 miles west of Adelaide, suitable for the berthing of oversea boats of deep draught. The structure will be 795ft. long and 53ft. wide, and is to be provided with the necessary railway lines and cross-overs to facilitate working operations. The pier is to be wholly of timber, and, it is expected, will be completed within eighteen months.

AN expert report on wage reductions in Swedish industries shows that the following percentage reductions have been effected in the various branches:—Iron and steel, 30–40; machine shops, 17; paper, 20–30; woodworking and furniture, 25; textiles, 20; mining, 20–25; pulp, sawmills, tobacco and municipal, 15; lime and brickworks, 12–20. The average reduction amounts to about 17 per cent., which nearly corresponds to the fall of 16 per cent. in the cost of living as calculated by the Social Board.

A COMMITTEE has been appointed to re-examine, more particularly in the light of the further information which has become available since the inquiries of the Departmental Committees appointed in 1911, the question of the danger from the use of lead paints to workers in the painting trades, and the comparative efficiency and cost, and the effect on the health of the workers of paints containing lead and leadless paints respectively. Sir Henry Norman is the chairman, and Mr. C. W. Price, of the Home Office, the secretary.

THE United States Department of Commerce has established a branch office at Manila with the object of getting more accurate information regarding trade in the Philippines. The Officer-in-Charge has stated that the United States, whose trade with South America and Europe is at present diminishing on account of exchange conditions, is turning its attention to the development of trade with the Far East for which Manila is a good centre. The Department of Commerce has, it is stated, approved a scheme for the development of the port and is committed to the project of a free zone there.

WE are informed that the Agent-General for New South Wales has received intimation from his Government that it is proposed to invite tenders for the erection of the North Shore Bridge spanning Sydney Harbour. The bridge will carry a railway and tramway as well as ordinary vehicular and pedestrian traffic, and will, it has been estimated, take ten years to complete. The specifications are expected to reach London about the end of November, when further notification will be made in the British and continental Press. It is understood that the closing date for tenders will be September, 1922.

MR. W. G. WICKHAM, his Majesty's Senior Trade Commissioner in South Africa, is engaged on an official tour of this country for the purpose of discussing with firms the possibilities and conditions of United Kingdom trade with the Union of South Africa. The first part of his tour includes the following towns:—Leicester, September 19th–21st; Nottingham, September 22nd–23rd; Sheffield, September 28th–30th; Leeds, October 3rd–5th; Bradford, October 6th–11th. Firms in these centres desiring to interview Mr. Wickham should communicate immediately with the secretary of their local Chamber of Commerce. Arrangements to visit other industrial centres will be made and notified in due course.

WE are informed that the Belgian Minister of Public Works has recently called the attention of the Administration des Ponts et Chaussées to the fact that tenders for contracts are frequently accepted in the interests of the Treasury despite the fact that they deviate from the prescriptions laid down in the specification in respect of the materials to be used. To prevent this practice, a clause, in future, is to be inserted in specifications to the effect that any tender which does not conform with the prescription of the specification will be considered null and void, and that if irregular tenders are submitted despite this warning it will be permissible to make use of them in the examination of similar undertakings.

IN view of the difficulty of dealing adequately with calls for tenders by public bodies in Italy, when the tendering firm is of foreign origin, the question of establishing a native house for the purpose has recently been considered by the Commercial Counsellor to his Majesty's Embassy at Rome. In the opinion of the legal adviser to the Embassy, United Kingdom contracting firms might find it advantageous to consider the question of establishing branch houses ("filiali") in Italy, the directors of which can be either British or Italian. British firms who may wish to adopt the course suggested can obtain particulars as to the formalities necessary for registration and information on the taxation to which they would become liable on application to the Department of Overseas Trade.

# THE SHIPPING AND ENGINEERING EXHIBITION AT OLYMPIA

(For description see page 290)

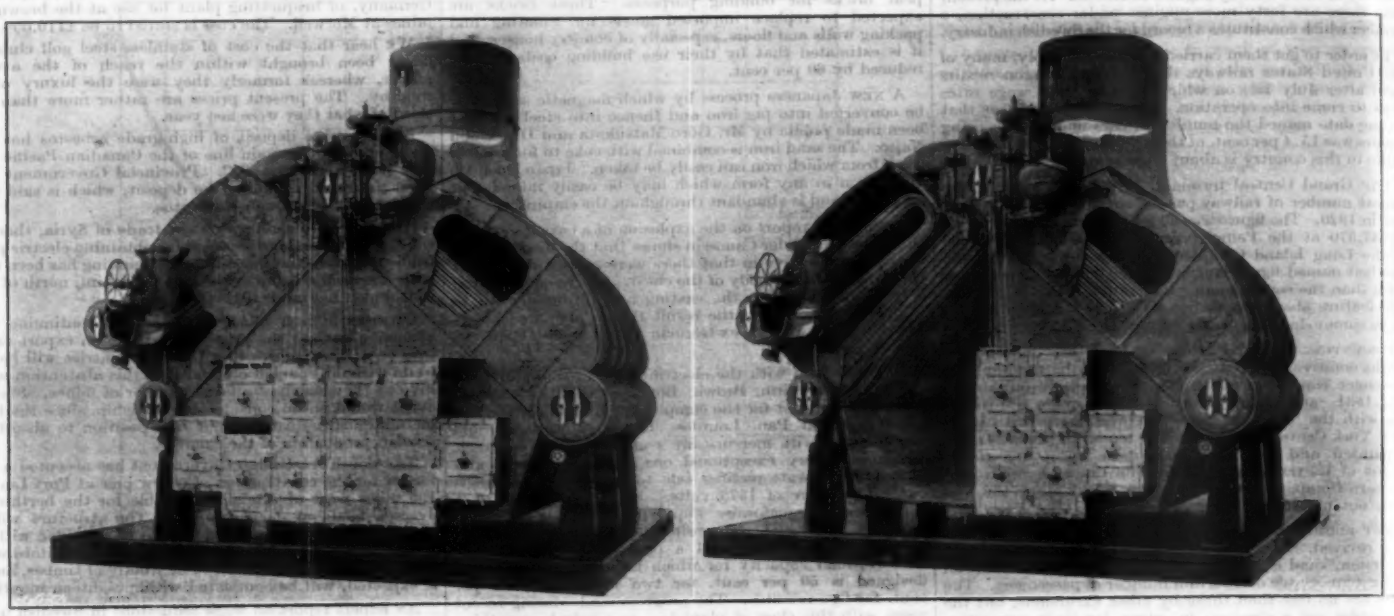

FIG. 23—MODEL OF YARROW 10,000-S.H.P. OIL-FIRED BOILER

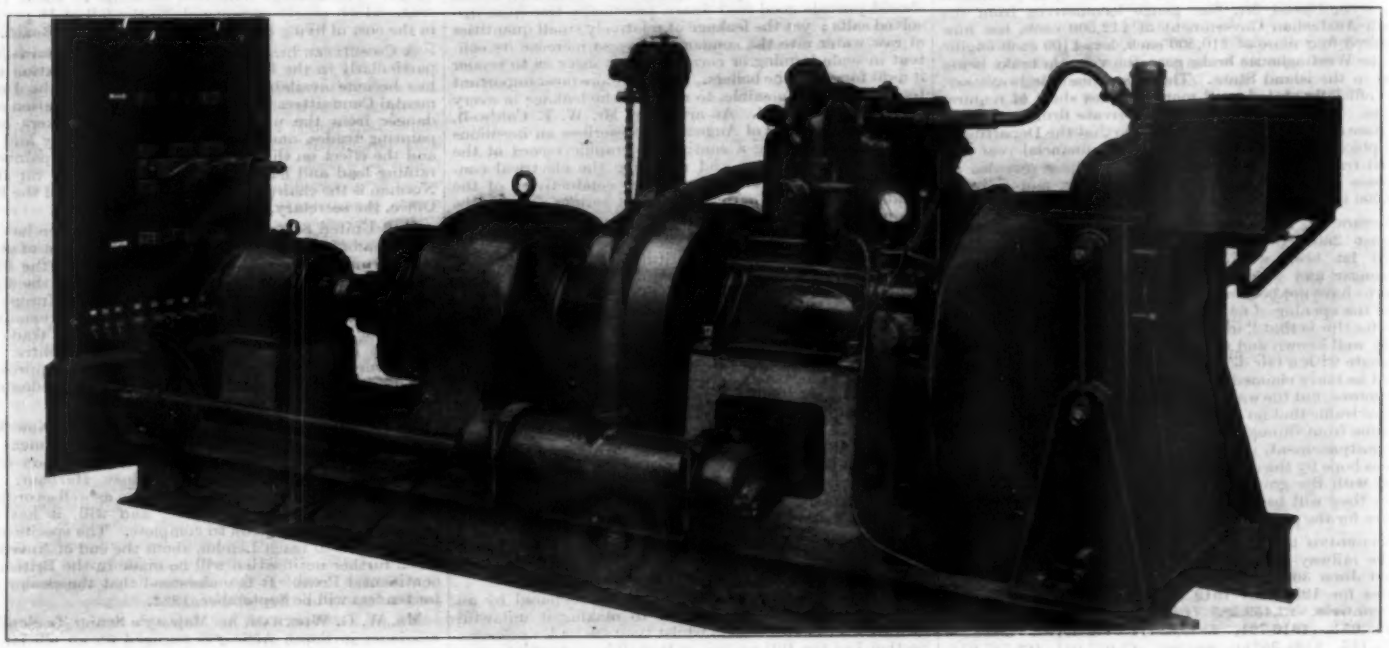

FIG. 24—PREMIER ELECTRIC ARC WELDING PLANT

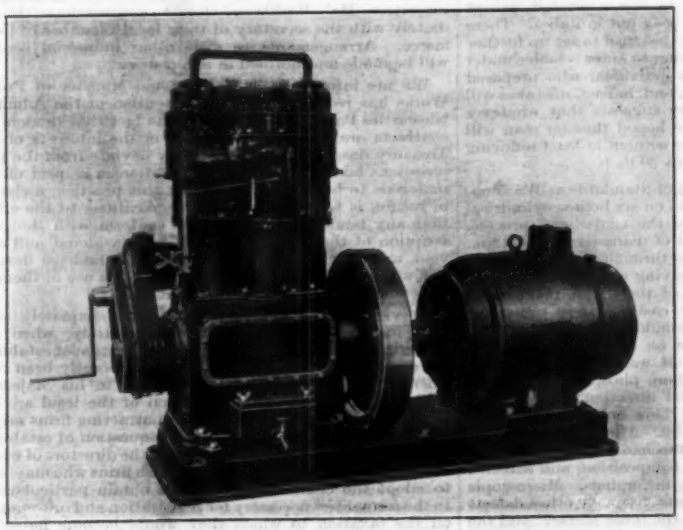

FIG. 25—RECORD 16-K.W. LIGHTING SET

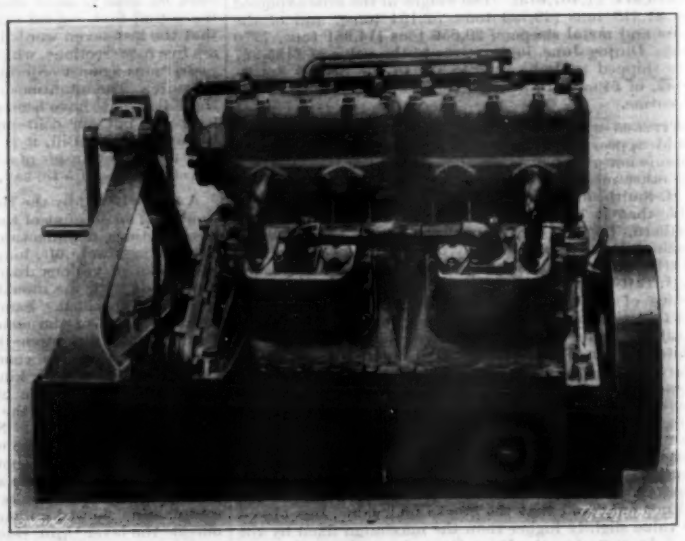

FIG. 26—RECORD 20-H.P. PARAFFIN MARINE ENGINE

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*By arrangement with Reuter's Engineering Service,* **The Engineer** *contains the latest news from all parts of the world which is likely to be of interest to engineers.*


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# THE ENGINEER.

*SEPTEMBER* 16, 1921.


### France and Britain.

IT would be idle to pretend that anything more than a superficial view of the relationship between France and Britain could be obtained in the space of a few days. Yet the opportunities for studying this problem which were presented by the recent meetings of the Iron and Steel Institute in Paris, and by the visits to the great iron and steel centres in Normandy, in Lorraine, or at Creusot and St. Chamond, were of an exceptional kind, since they made it possible to obtain the opinions of many Frenchmen and to compare them at once with the opinions of British iron and steel manufacturers and merchants. It is for this reason, and for this reason alone, that we venture to give a few impressions which we recognise fully are derived from a shallow inquiry. But we may claim, with some justice, that this view of the patent facts has at least one advantage over a deeper examination. Unfortunately, it cannot be denied that both in France and in Britain the iron and steel trades are the subject of a certain amount of commercial and political intrigue which obscures the plain issues and from the confusion of which we escape by looking merely at the obvious and salient features.

It was clear from the very earliest stages of the meeting that the iron and steel industry of France welcomed the opportunity of laying directly before the iron and steel industry of Britain its views on the international position. No occasion was missed either in public speeches or in private conversation to enforce the French conviction that Germany is smarting under defeat and preparing herself for another effort. Monsieur de Wendel, at the first meeting in the Hotel of the Comité des Forges, said that if we lived and worked, as he did, at the frontier between France and Germany we should see what was going on as plainly as France saw it. It was only because we were separated from Germany by intervening states, and by a strip of sea, that we took a less sinister view of Germany's activities. At the same meeting Monsieur Guillet insisted that the destruction of French factories was carried out by the Germans for economic reasons. It was not, he said, due to the accidents of war; it was deliberate and scientific; executed with the purpose of crippling French industry in the future. On subsequent occasions speakers advanced the same opinions. They asserted that Germany meant to make the recovery of French industries well nigh impossible, and that she would sooner or later embark on a new war to recover what she had lost and to seize upon more. These two views seemed to us to stand out as the leading facts of French opinion, and it is around them that such friction as does exist between France and Britain has arisen. For, on the one hand, France holds that since the destruction of her factories was carried out by Germany with economic purposes we should help her to restore them as quickly as possible; and, on the other hand, since Germany will attack France again as soon as she can gain sufficient power, that we should take more active steps to insist upon the smallest detail of the Treaty of Peace. These appeals were placed before the British visitors in various forms, but never—and we desire for the sake of the friendly relationships between the two countries that it should be particularly observed—but never with the slightest trace of rancour. The speakers addressed us with the calm conviction of those adducing irrefutable arguments, and never with heat or undue sentiment. They neither reproached us bitterly for what we had not done, nor appealed to us *in formâ pauperis* for help. For ourselves we must admit that we were impressed by the quiet, logical nature of their addresses. However different may be the views about the great issues that face our friend and neighbour, there can be no doubt whatever that she speaks with sincerity and conviction, and that she believes the security of Europe is to be attained by the restoration of French industry and by the severe repression of Germany's efforts to renew her military strength. These French speakers asked for sympathetic understanding of their problems. We do not think it is really lacking. Great Britain acknowledges and appreciates the sacrifices and services of France, and there was no phrase in all the speeches made that received heartier applause than that of the Mayor of Lyons when he said that, despite legitimate differences the road to the peace of Europe lay in the same direction for both France and England. But whilst we are seeking to understand France it is only just that we should invite her in her turn to understand us and our peculiar troubles. British engineers and iron and steel workers have now seen something of the condition of the works in France; they know a great deal must yet be done before recovery is effected; they know that there is much unemployment and much distress. Perchance if a French deputation could come, now, to these shores; if it could see our silent factories, our cold blast-furnaces, our idle mills, and our hundreds of thousands of workless men, France would admit that we, too, have our economic problem, that we cannot help her financially, and that we are so placed that we cannot sacrifice any portion of the long-prayed-for revival of trade. We believe, as Sir Hugh Bell said in reply to Monsieur de Wendel, that there is enough trade to go round, enough trade to satisfy France and England, Italy and Belgium, and even, he added, Germany. But that trade is still dead; we are still waiting for its resurrection; and anxious as we may be to see France enjoying her share of it when it comes, we cannot afford at the present time to sacrifice any part of our prospect in it in order to build up her industries. Indeed the impression left upon our minds was that France at the moment is not much worse off than Britain. Some of her factories, it is true, are idle, but others are busy, and wherever we went we saw new shops being erected on a splendid scale. France, there can be no doubt, intends to take advantage of the magnificent resources of Lorraine to build up a greater iron and steel industry than that destroyed by the war. She must of necessity come into the export trade of the world as a more powerful competitor than ever before. Can she with fairness ask us for our help at a time when we are groaning under excessive taxation, when a new social movement has disturbed the whole balance of manufacturing costs, and when our own industries are languishing and dying? She asks us for what we willingly give, our sympathy; may we not, in our turn, ask her to endeavour to see our attitude towards Germany in our light. The view is held by our economists that a sound and peaceful Europe is impossible as long as one member is sick. They believe that German trade must be allowed to re-develop just as must that of Russia. Whether or not we are taking the proper steps to prevent renewed aggression by Germany is a question we leave gladly to politicians, but we can at least assure French engineers that there is but one desire in Great Britain, and it is to see the peace of all the nations of Europe restored and the commerce of all regained and increased.

There is no nation for which Great Britain has greater admiration, none with which it has more sympathy than France. It knows what France suffered, it knows the nature of the German attack upon her industries, it appreciates her fears of a new invasion, a worse war. It knows that in the struggle to regain industrial stability there must be rivalry, friction and misunderstanding; but convinced as it is that the unity of France and Great Britain is the best guarantee of peace in Europe, it looks for the maintenance of friendship and the tolerance that comes from understanding. "Prejudices," said the Vice-President of the Chamber of Commerce at a magnificent banquet given to the Iron and Steel Institute by the municipality of Lyons, "prejudices flourish on ignorance and are worn away by contact."

We venture to hope that the visit of the Institute to France, the intimate contact between the ironmasters of the two nations, may lead to a greater and better understanding and may do something to dispel the clouds which seem sometimes to overshadow a friendship which has done so much to secure the peace of the world.

### The Good and Evil of Science.

In his presidential address to the British Association Sir Edward Thorpe touched upon several aspects of modern chemical science, but it is already clear that so far as the general public is concerned his remarks upon what is known as "chemical warfare" have attracted chief and almost sole attention. As we reprinted in last week's issue only that portion of his address in which he revealed in a most interesting manner the latest development of ideas regarding the structure of the "elements," it may be as well if we here state that in the concluding part of his remarks Sir Edward discussed the application of chemical science to warfare, and held up to execration the employment in war between civilised nations of lethal gases intended to kill or neutralise the enemy's forces. He admitted that after the first German gas attack, on April 25th, 1915, we and our allies had no alternative but to follow suit in this "illegal" form of warfare, but he urged that steps should now be taken to stop the use of poisonous gases, liquids or solids in any future war. He appealed to the Association to use its influence in this direction and pleaded that credit should be withheld from "any body of scientific men who employed their talents in devising means to develop and perpetuate a mode of warfare which was abhorrent to the higher instincts of humanity." By augmenting the horrors of war in this way science, he said, was being degraded and was leading us on a course that was the very negation of civilisation. The moral sense of the world should make its influence prevail in order that a practice that was repugnant to the right feeling of humanity should not be allowed to establish itself as a recognised instrument of war. Sir Edward may perhaps have been led thus to express himself by a feeling that some sort of apology and recompense were due to humanity by chemists for the horrors caused in the course of the war by the application of their knowledge to destructive ends. Such an apology is, however, required from the chemist no more in connection with poison gases than in connection with high explosives, and no more from the chemist than from the engineer, the physicist, the doctor and all others dealing in science. It is not necessary from any of them, for the offences of science are beyond the power of scientists to control.

As a chemist we have the greatest possible respect for Sir Edward Thorpe, and for long have taken him as our guide and master in chemical science. But when, straying from the strict paths of his own special subject, he seeks the fields of humanitarianism, we find ourselves at total variance with his philosophy. The subject he has raised cannot possibly be confined with justice and any respect for logic to the chemistry aspect; if we must deal with it at all, we must regard the bearing on war not of any one branch of modern science but of the whole of it. As opposed to the view apparently held by Sir Edward, we would submit that science in all its branches is entirely soulless, essentially unhumane, quite beyond man's power of control and completely removed from the sphere of his ability either to degrade or elevate. We may be unwilling to admit the truth of these views, and it is possible that our unwillingness to do so increases with the increased possession of scientific ability. Yet no good can come of holding a false view, however repulsive the correct one may be. Some will perhaps be tempted to say that in our summing up of all science as a soulless Moloch we have overlooked the medical branch. We have not; indeed, of all the branches, medicine and surgery can be the most unhumane. The ability of modern nations to put millions of men into the field and keep them healthy under abnormal conditions, the soldier returning to the front with seven wound stripes, would be impossibilities but for medical and surgical science. The engineer is not alone responsible for modern conditions of war; he supplies the material, but the scale upon which it is used rests ultimately with the doctor. Science of itself is not essentially benign, nor is it essentially evil. Being as it is merely man's knowledge of the material universe, it cannot be less kind or cruel than Nature herself. We may—and in normal times do—seek to extend our knowledge of Nature along those paths in which her beneficence to man is apparently most marked. But with each benefit she hands out the power to do evil. The most potent medicines are the most deadly poisons. The steam engine has added immeasurably to man's ability and opportunity to do evil to his fellow men. The "conquest" of the air has so far been responsible for more misery than happiness to the "conquerors." It is folly to suppose that science is invariably on the side of goodness. In reality it is just as indifferent as Nature herself to the good of humanity. To attempt, therefore, to limit scientific progress to its beneficent side would be as reasonable as to try to alter gravity or to shift the earth's equator. If we are never to make an advance for fear of the evil ends to which that advance might be put we shall never wrest increased benefit from Nature. Moreover, to suppose that by any kind of moral pact a man or a nation fighting for his or its very life would be restrained from employing the "evil" forces of science is to display a faith in human nature which is not warranted by our knowledge of man's descent.

It is strange indeed to notice that while Sir Edward Thorpe seeks to influence public opinion against the perpetuation of chemical warfare, he, in another part of his address, deals with the problem of the essential nature of matter, dwelling on its greatness and importance, and, by inference, emphasising the value to mankind of the knowledge which is now being accumulated in this field. For the time being the problem is not of practical significance, but it is quite probable, and more than conceivable, that in the years to come those now investigating it will be held up to far greater execration by another humanitarian President of the British Association than Sir Edward has poured on the heads of those who would seek to continue and to justify "chemical" warfare. Within the atom there seem to lie the means for man to produce evil of a magnitude vastly greater than the worst that can be done by poison gases, high explosives, and all the armoury of war as we recently knew it. Yet shall we bid Sir Joseph Thomson and his fellow-investigators cease their work? Can we hope that if they do all others will do likewise? We believe that for weal or for woe we cannot stop the march of science, that once having begun to prise open Nature's secrets it is not within our power to prevent their working out, whether or in whatsoever degree their effect is beneficent or evil. To what end, then, is scientific discovery leading us? Recent experience has irresistibly demonstrated that the progress of the past fifty years has not only altered our lives and habits in a profound and beneficial manner, but has also placed within our power the means to do evil to our fellow men of a kind and on a scale equally profound and great. Will the balance between the good and evil forces of science continue to be preserved or will it lean gradually towards one side? If the forces for our betterment prevail the League of Scientists will make war impossible or at any rate futile. But if the other, then science will ultimately prove the destroyer of the human race. We cannot answer the question, but of this much we are convinced, that it will be answered for us, and that nothing we can do or say or leave undone or unsaid will affect the matter.

## Obituary.

### JOHN PEARCE ROE.

We regret to have to record the fact that Mr. John Pearce Roe, chairman and managing director of Ropeways, Limited, Eldon-street House, E.C. 2, died on the 2nd inst. Mr. Roe was the son of Mr. John P. Roe, a civil engineer of Consett, Durham, and was born at Bridgend, South Wales, in 1852. After being educated by a private tutor, he began his engineering career in his father's works at Cardiff. In 1870 he joined the Dowlais Iron Company, being employed at first in the drawing-office and subsequently as a general assistant engineer in connection with the company's iron and steel works and collieries. In 1879, at the request of Mr. Menelaus, of the Dowlais Company, and also of the Orconera Iron Ore Company, Mr. Roe proceeded to Bilbao to investigate and install provisional means of getting the output of the mines on board the ships. On the completion of this work he was appointed the company's resident engineer, and in that capacity designed and carried out a large amount of work in connection with the railway, shipping appliances, river walls, dredging, and feeder transport arrangements to the main line, including heavy inclined plane work. In 1889 he commenced practice as a consulting engineer at Cardiff, and undertook contracts for transporting minerals by means of aerial ropeways in the Bilbao district. In the following year he opened offices in London, and while devoting himself particularly to the development of what is now known as the Roe system of ropeways for transporting material in mountainous countries, he eventually formed a company under the name of Ropeways, Limited, which under his management and control has carried out a great number of important installations in all parts of the world. In addition to supervising the entire work of the company, he practised as a consulting engineer, advising on various engineering matters, particularly in connection with the handling and transport of minerals and the like.

## Problems of Physics.*

My predecessor in office a year ago reminded you that the theoretical researches of Einstein and Weyl suggest that not merely the material universe but space itself is perhaps finite. As to the probabilities I do not wish to express an opinion; but the statement is significant of the extent of the revolution in the conceptions and fundamental principles of physics now in progress. That space need not be infinite has, I believe, long been recognised by geometricians, and appropriate geometries to meet its possible limitations have been devised by ingenious mathematicians. I doubt, however, whether these inventive gentlemen ever dreamed that their schemes held any objective validity such as would assist the astronomer and the physicist in understanding and classifying material phenomena. It is not certain that they will; but the possibility is definite. Apart from this, the whole development of relativity is an extraordinary triumph for pure mathematics. Had Einstein not found his entire calculus ready to hand, owing to the purely mathematical work of Christoffel, Riemann, and others, it seems certain that the development of generalised relativity would have been much slower.

Relativity is the revolutionary movement in physics which has caught the public eye, perhaps because it deals with familiar conceptions in a manner which for the most part is found pleasantly incomprehensible. But it is only one of a number of revolutionary changes of comparable magnitude. Among these we have to place the advent of the quantum, the significance of which I hope we shall thoroughly discuss early next week. The various consequences of the electronic structure of matter are still unfolding themselves to us, and are increasing our insight into the most varied phenomena at a rate which must have appeared incredible only a few decades ago.

The enormous and far-reaching importance of the discoveries being made at Cambridge by Sir Ernest Rutherford cannot be over-emphasised. These epoch-making discoveries relate to the structure and properties of the nuclei of atoms. At the present time we have, I think, to accept it as a fact that the atoms consist of a positively charged nucleus of minute size, surrounded at a fairly respectful distance by a number of electrons requisite to maintain the structure electrically neutral. The nucleus contains all but about one-two-thousandth part of the mass of the atom, and its electric charge is numerically equal to that of the negative electron multiplied by what is called the atomic number of the atom, the atomic number being the number which is obtained when the chemical elements are enumerated in the order of the atomic weights; thus hydrogen = 1, helium = 2, lithium = 3, and so on. Consequently the number of external electrons in the atom is also equal to the atomic number. The evidence, derived from many distinct and dissimilar lines of inquiry, which makes it necessary to accept the foregoing statements as facts, will be familiar to members of this section of the British Association, which has continually been in the forefront of contemporary advances in physical science. But I would remind you in passing that one of the important pieces of evidence was supplied by Professor Barkla's researches on the scattering of X-rays by light atoms.

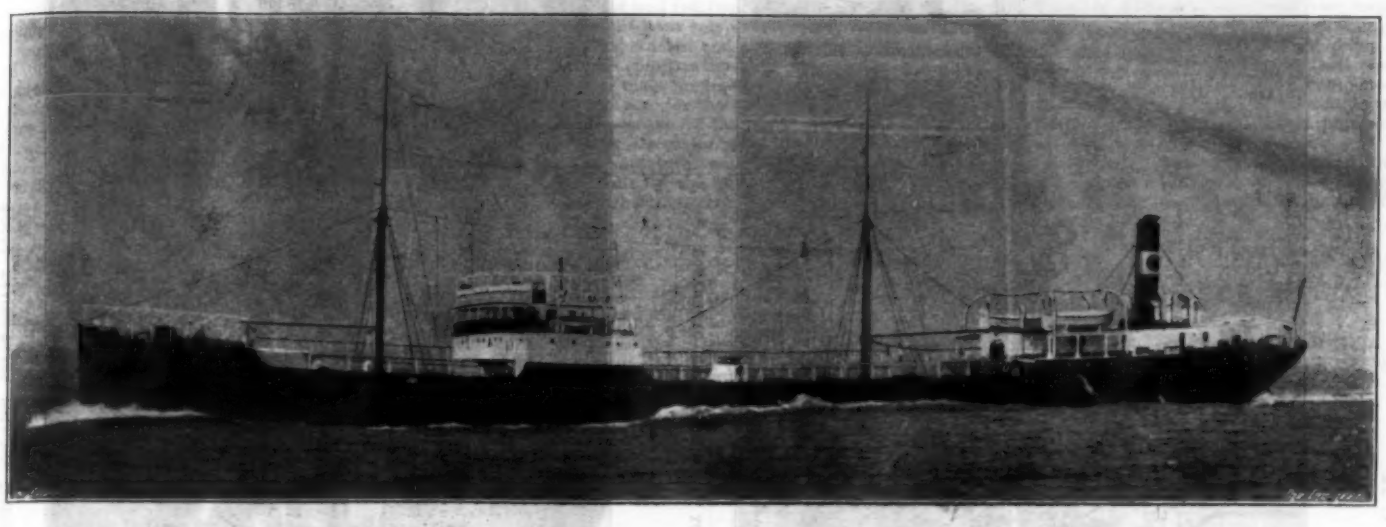
The diameters of the nuclei of the atoms are comparable with one-millionth of one-millionth part of a centimetre, and the problem of finding what lies within the interior of such a structure seems at first sight almost hopeless. It is to this problem which Rutherford has addressed himself by the direct method of bombarding the nuclei of the different atoms with the equally minute high-velocity helium nuclei (alpha-particles) given off by radio-active substances, and examining the tracks of any other particles which may be generated as a result of the impact. A careful and critical examination of the results shows that hydrogen nuclei are thus expelled from the nuclei of a number of atoms such as nitrogen and phosphorus. On the other hand, oxygen and carbon do not eject hydrogen under these circumstances, although there is evidence in the case of oxygen and nitrogen of the expulsion of other sub-nuclei whose precise structure is a matter for further inquiry.

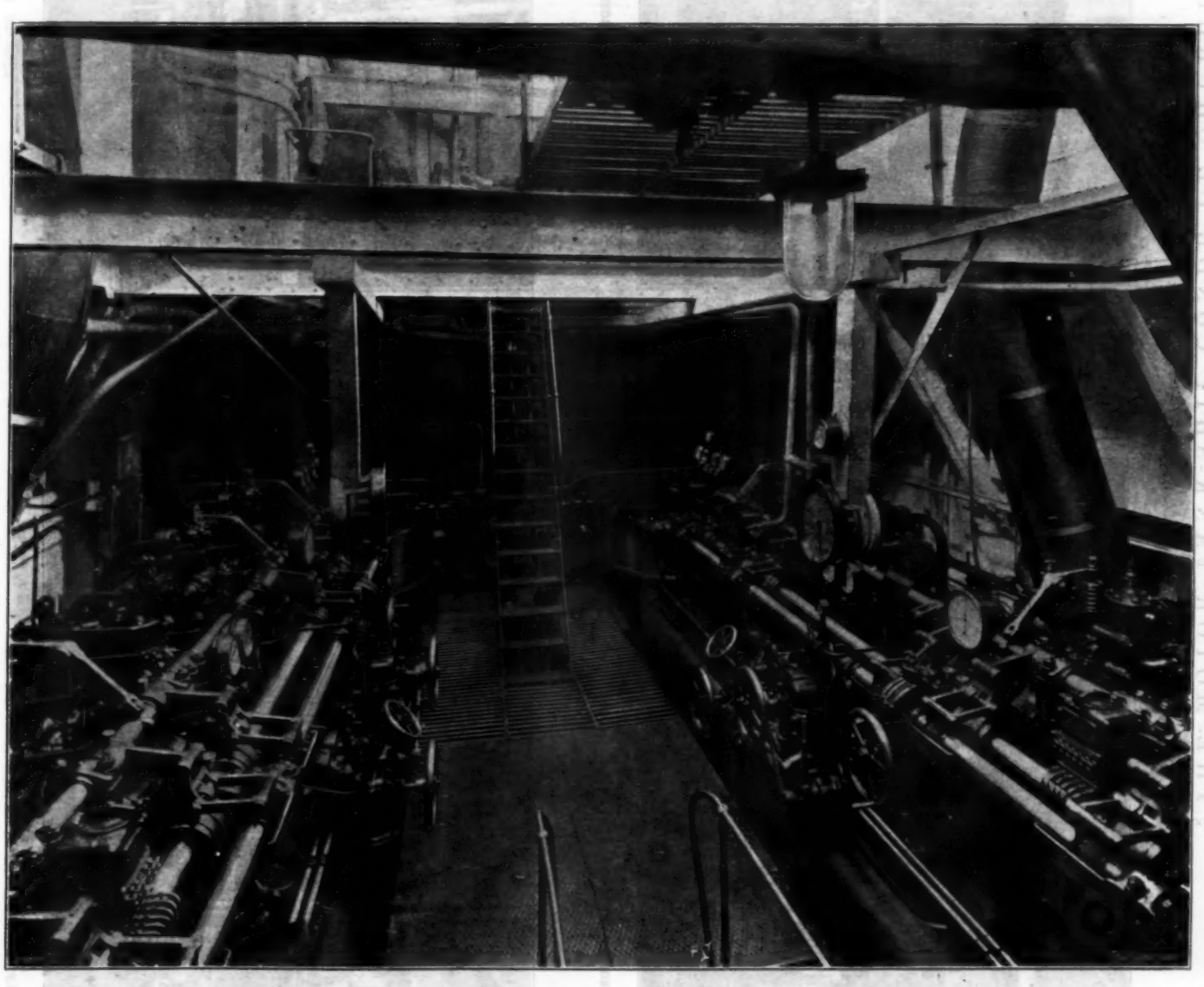
The artificial transmutation of the chemical elements is thus an established fact. The natural transmutation has, of course, been familiar for some years to students of radioactivity. The philosopher's stone, one of the alleged chimeras of the mediæval alchemists, is thus within our reach. But this is only part of the story. It appears that in some cases the kinetic energy of the ejected fragments is greater than that of the bombarding particles. This means that these bombardments are able to release the energy which is stored in the nuclei of atoms. Now, we know from the amount of heat liberated in radioactive disintegration that the amount of energy stored in the nuclei is of a higher order of magnitude altogether, some millions of times greater, in fact, than that generated by any chemical reaction such as the combustion of coal. In this comparison, of course, it is the amount of energy per unit mass of reacting or disintegrating matter which is under consideration. The amounts of energy which have thus far been released by artificial disintegration of the nuclei are in themselves small, but they are enormous in comparison with the minute amounts of matter affected. If these effects can be sufficiently intensified there appear to be two possibilities. Either they will prove uncontrollable, which would presumably spell the end of all things, or they will not. If they can be both intensified and controlled, then we shall have at our disposal an almost illimitable supply of power which will entirely transcend anything hitherto known. It is too early yet to say whether the necessary conditions are capable of being realised in practice.

* British Association: from the presidential address of Professor O. W. Richardson to Section A (Mathematics and Physics).

# THE MOTOR TANK-SHIP CONDE DE CHURRUCA

SIR W. G. ARMSTRONG WHITWORTH AND CO., LIMITED, NEWCASTLE-ON-TYNE, BUILDERS





ENGINE ROOM—UPPER PLATFORM, SHOWING MANŒUVRING GEAR

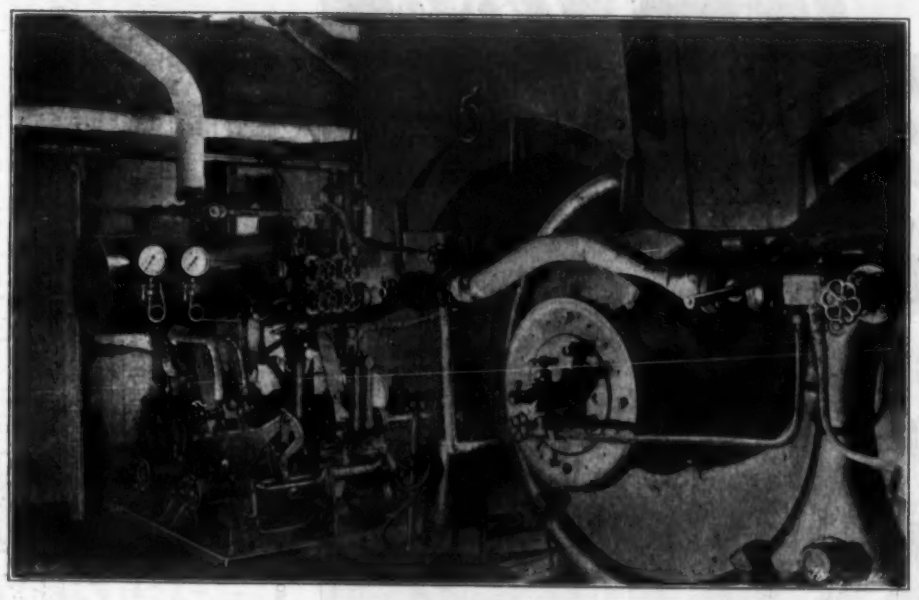
## The Motor Tanker Conde de Churruca.

AN important event took place on Thursday, the 8th inst., when a large company of guests, representing the Admiralty, the Board of Trade, British and foreign Surveys, and the chief shipping and oil interests accepted the invitation of Sir W. G. Armstrong, Whitworth and Co., Limited, to attend the demonstration trials of the recently launched twin-screw oil tanker Conde de Churruca, which is propelled by Armstrong-Sulzer Diesel engines. The interest of the occasion was enhanced by the presence of Dr. Hans Sulzer, Mr. Robert Sulzer, and Mr. Schenker, representing Messrs. Sulzer Bros., Winterthur, Switzerland, and by the fact that the two 1250 brake horse-power engines installed embody Messrs. Sulzer's newest marine designs and are the largest engines of this type which have, up to the present, been fitted in a British mercantile vessel.

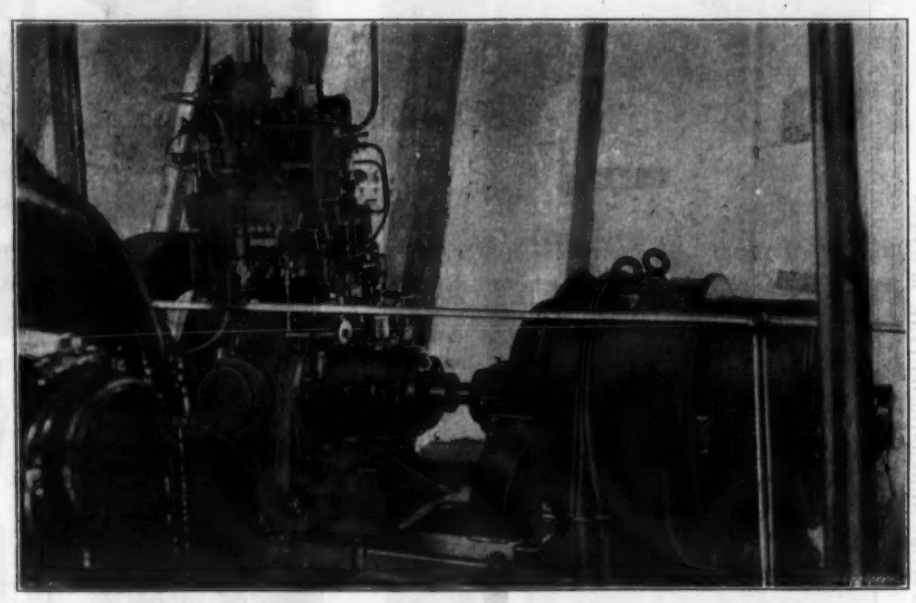
The vessel and machinery spaces were open for inspection during the morning, and at mid-day luncheon was served at the company's offices before the vessel left for sea. Messrs. Armstrong, Whitworth and Co. were ably represented by Mr. H. G. Williams, general manager of the Shipyards Department, who presided, and was supported by the following gentlemen :—Mr. F. E. W. Coller, manager of the Naval Yard ; Mr. A. Douie, manager of the Walker Yard ; Mr. H. Thomson, general manager of the Engine Department ; Mr. Hinchcliffe, Mr. Matthews, and Mr. Everett. Replying to the welcome extended to the guests, by Mr. Williams and Mr. Thomson, Dr. Hans Sulzer expressed his warm admiration of the work done by Messrs. Armstrong, Whitworth and Co. and their cordial co-operation in installing and arranging in the Conde de Churruca the engines built by his firm. He was especially proud that Sulzers had succeeded in obtaining the support of British friends for their engines, for they had always recognised that without the co-operation and assistance of the experts of the nation, which, for centuries, had been considered, and to-day was still considered,

# THE MOTOR TANK-SHIP CONDE DE CHURRUCA

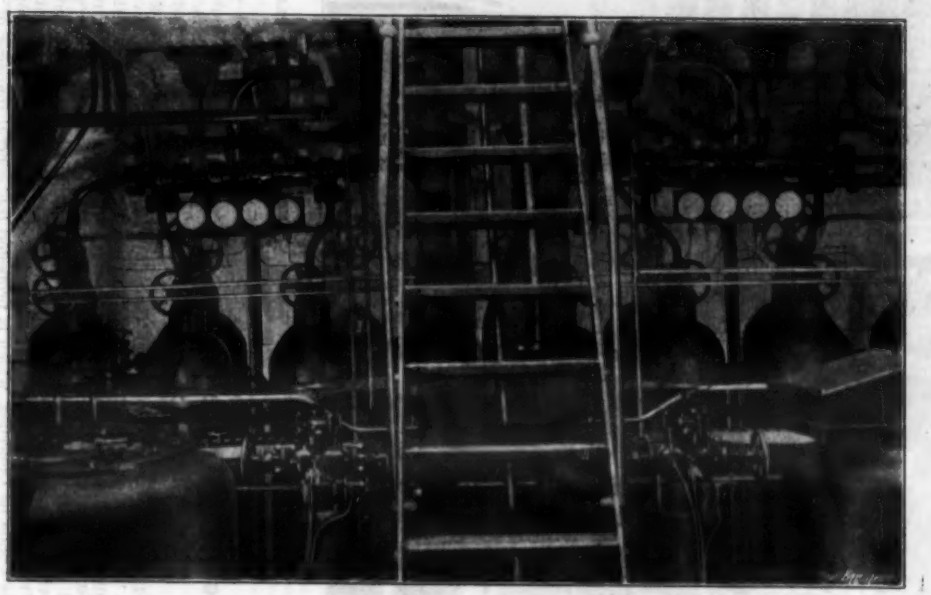
(For description see page 297)



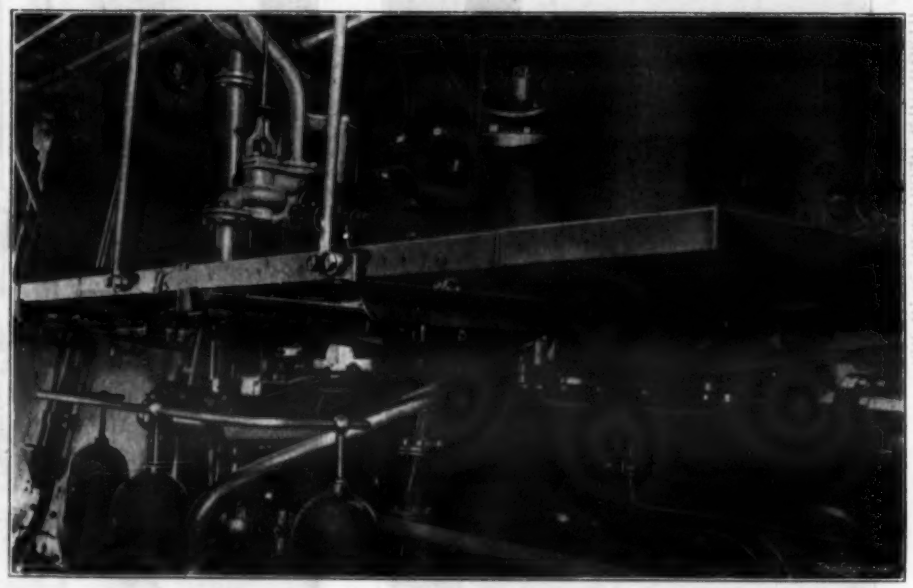
DONKEY BOILER WITH OIL FUEL GEAR ON THE LEFT



EMERGENCY COMPRESSOR AND GENERATOR



HIGH-PRESSURE AIR BOTTLES—TOP PLATFORM



BACK OF ENGINE, SHOWING LEVER-DRIVEN PUMPS

the authority on all matters pertaining to engineering and shipbuilding, real success with their marine engine could not be achieved. With regard to the engine, he would prefer those present to form their own opinions during the trials that were about to take place. All he would say was, that the design represented the outcome of over twenty years' practice, experiment and research. An engineer must always be a modest man, one who recognised that no design could be perfected without combined effort, and that many minds must plan and many hands carry the stones required in the building of the temple of technical science. He felt that every engine had a spirit of its own.

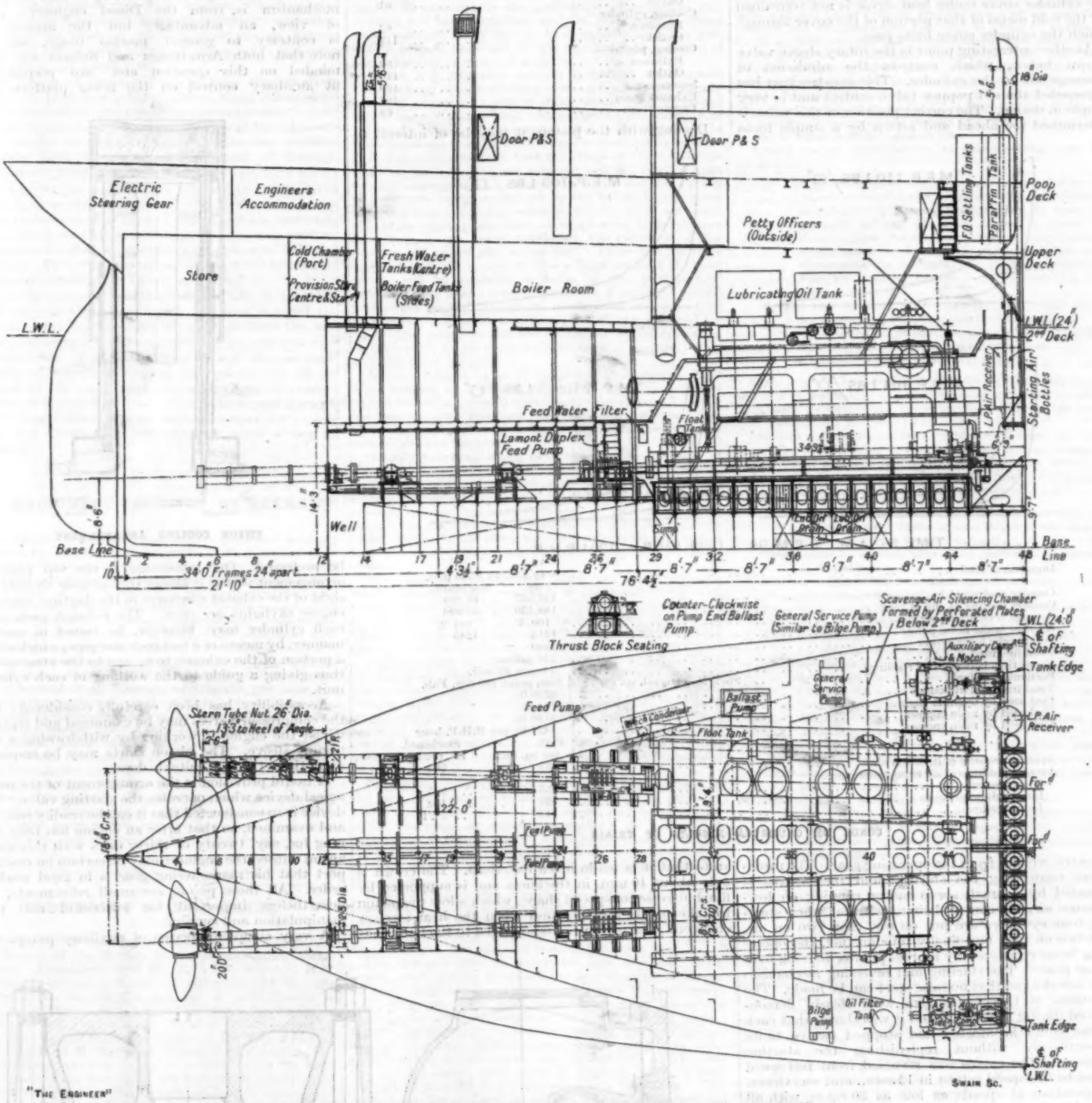
The firm he had the honour to represent was founded nearly ninety years ago, and during three generations had studied English methods and business principles, recognising the essential value of them in the building up of its business. Dr. Sulzer recalled with pleasure the excellent work of Mr. Chas. Brown, whom his father brought over to Switzerland in the early 'sixties to help him with steam engine design. Mr. Brown had laid the foundations of the company's success with the modern steam engine, and his work had influenced the design of the Sulzer Diesel engine. In a real sense the spirit of the Sulzer engine was the British spirit. It was interesting to remember that Mr. Brown was for some time associated with Messrs. Armstrong, Whitworth's shipyard at Naples, and that to-day Mr. Brown's two sons were heads of the famous Swiss firm, Messrs. Brown, Boveri and Cie. He expressed the hope that the co-operation between Swiss and British engineering firms would grow closer every day.

Leaving the Naval Yard about 1.30 p.m., the trials were carried out. They included full-power runs on Diesel oil and boiler fuel oil, specific gravity .93, and various manœuvring tests. Throughout the day the engines ran with a pleasing steadiness and absence of vibration, and both on Diesel oil and boiler fuel oil and at low load and full load a clean exhaust was maintained, a slight haze only being visible when the engines were being started and stopped and adjusted to load. It was comparatively easy to judge the exhaust from the main engines, as separate uptakes are fitted for them and for the donkey boiler.

The general appearance of the ship and the arrangement of machinery and auxiliaries will be clearly seen from the photographs and plans reproduced in this number. Built for the Sociedad Commercial de Oriente de San Sebastien (represented by M. Samuel and Co., Limited, London), the Conde de Churruca is a steel twin-screw motor tanker of the following dimensions :—Length between perpendiculars, 370ft.; breadth extreme, 48ft. 7in.; depth moulded, 30ft.; gross tonnage, 4550, with a mean draught of 24ft. 3in. with 6500 tons deadweight on board; and a speed of 11¼ knots when thus loaded. She has been built under special survey to meet the requirements of Lloyd's for their 100 A1 Class, and also to conform to the rules of the British Board of Trade. The vessel is of the two-deck type with poop, bridge and forecastle, and has a raked stem and elliptical stern. Accommodation for the captain and officers is provided in a steel house on the bridge deck. The engineers', petty officers', and greasers' quarters are in the poop and the seamen are accommodated in the forecastle. The framing is on the Isherwood longitudinal system.

The deck machinery, consisting of the anchor windlass, winches, and derricks, is all steam driven, the steam being raised in an oil-fired donkey boiler fitted in the engine casing, which also provides steam for the heating coils in the cargo and fuel tanks. The donkey boiler shown in part on page 298 is 10ft. 6in. external diameter, 11ft. 6in. long, with two furnaces and natural draught. The oil firing installation is of the Wallsend-Howden type, with spare pump. A surface condenser of 600 square feet surface, a small feed pump, feed filter, and float tank complete the boiler auxiliaries. The oil cargo is carried in seven double compartments with the usual pump-room extending from side to side of the vessel.

Fuel oil is carried in a cross bunker forward of the engine-room and in double-bottom tanks under the engine. Two "ready use" tanks, each capable of




THE CONDE DE CHURRUCA—ELEVATION AND PLAN OF PROPELLING MACHINERY

A view on page 297 shows the top platform of the main engines. Each engine develops 1250 brake horse-power, at 100 revolutions per minute, in four cylinders, the dimensions of the cylinders being 600 mm. bore and 900 mm. stroke. The scavenge pump and the three-stage air compressor are grouped at the end of the engine, along with a set of three single-acting pumps, one for piston cooling, one for bilge water, and one for sanitary service, which are shown on page 298, and are driven by levers from the scavenge pump crosshead. This group of pumps forms an important balancing unit along with the other four main cylinders and assists in the quiet running of the engine.

The general principle of the Sulzer engine was recently described in an article on "Modern Marine

Oil Engines"—see THE ENGINEER of August 12th—but it will not be out of place to mention and comment upon some special points of design which distinguish the Sulzer engine in the field of the two-stroke marine engine.

The question of cylinder cover design has always been a vexed one for Diesel engineers, and the opposed piston type of engine finds advocates on the ground that there are no cylinder covers, although expensive and complicated constructions are often thereby introduced. Messrs. Sulzer's solution of this problem has been to reduce the cylinder cover casting to a simple symmetrical casting with only one centre opening, which takes the combined fuel and starting valve casing. In the latest design, shown below, the main body of the casting stops at a point just beyond the spigot, which means that the portion of the cylinder cover under heat stress is not restrained by the cold metal of that portion of the cover through which the cylinder cover bolts pass.

Another interesting point is the rotary sleeve valve shown below, which controls the admission of scavenge air to the cylinder. This construction has superseded the old poppet valve control and is very simple in design. The correct position of this valve is determined for ahead and astern by a simple loose excentric worked from the operating gear. The mechanism controlling the starting and fuel valves is actuated by a small servo motor running on low-pressure air, the control being such that when starting, four cylinders are put on air, then two on air, and two on fuel, and finally four on fuel, the operations being registered by a brass pointer moving over a dial plate. The starting and reversing mechanism is so interlocked that no false start can be made. The functions of this mechanism were clearly demonstrated during the trial, when it was shown that each engine could be started and stopped twelve times consecutively without replenishing the starting receivers. The engine was reversed from full speed ahead to full speed astern in 12 secs., and was shown in operation at speeds as low as 30 r.p.m. with all cylinders firing regularly.

The starting receivers are seen in a view on page 298 and are eight in number, each of 800 litres capacity. They can be charged from the main compressor of either of the main or auxiliary engines. A low-pressure receiver is also fitted, adjacent to the high-pressure receivers, and is supplied through a reducing valve. This receiver provides air service for the servo motors for the operating gear and the turning gear, which motors are similar in design and interchangeable, and also for the air-driven lubricating oil priming pump and the whistle.

Before proceeding to describe the auxiliaries attention may be called to the Sulzer spray system of piston cooling, shown diagrammatically above. Sea water is used as the cooling medium, and the whole system works under atmospheric pressure, open discharges being provided so that the engineer on duty can gauge the temperature of each piston and cylinder unit. During the war period an experiment was made to test the effect of heat stress on the delicate parts of the engine. The test engine was overloaded till the exhaust pipe was heated to redness and collapsed, and the engine was then stopped and opened up. When examined, the piston rings were intact and the lubrication was unimpaired, owing to the efficiency of the jet cooling system. The appended table gives particulars of the cooling water temperatures in a recent test.

*Temperatures in Degrees Fahrenheit.*

| | |
|---|---|
| Cooling water for air injection cooler | 54 |
| Air injection, one-stage cooler— | |
| Entrance | 212 |
| Outlet | 68 |
| Air injection, two-stage cooler— | |
| Entrance | 195 |
| Outlet | 80 |
| Air injection, three-stage cooler— | |
| Entrance | 316 |
| Outlet | 61 |
| Cooling, cylinder— | |
| Entrance | 63 |
| Outlet | 114 |
| Cooling, piston— | |
| Entrance | 52 |
| Outlet | 116 |
| Scavenge air | 100 |
| Exhaust gases | 464 |
| Engine-room | 68 |

Dealing with the piston, it may be of interest to state that it is made in two sections. The crown is only about 40 mm. in thickness and is supported by five buttresses of special shape, which allow the piston to take up its own position when the heat stresses come on. The piston-rod is so joined to the body that the piston is free to expand radially, and sticking has been entirely eliminated.

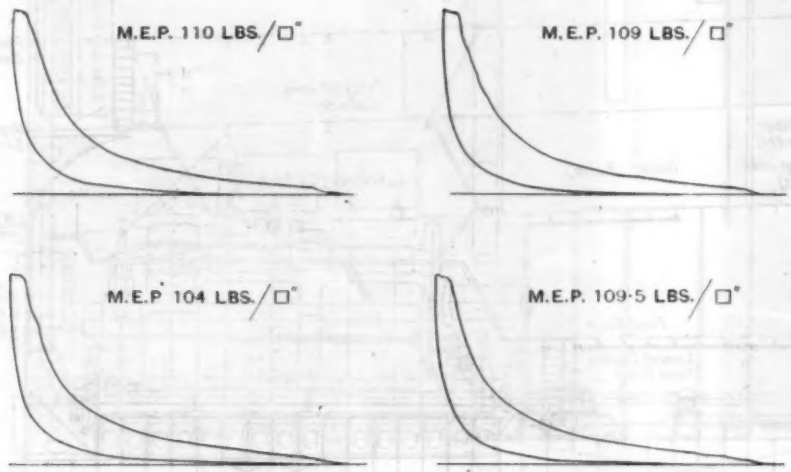
Objection has been raised to the two-cycle engine on account of the permanently highly stressed cross-head pin, no reversal of stress taking place as in the case of the four-cycle engine. Special means are adopted for maintaining efficient crosshead lubrication, a special pump being employed which takes its suction from the forced lubrication system and delivers oil to the crosshead pins at pressures up to 250 lb. to 300 lb. Such pressures are, however, only necessary on a new engine, and after a short period of running the oil pressure may be reduced to about 75 lb. The forced lubrication system on the Conde de Churruca is so arranged that the lubricating pumps deliver to a large overhead tank supplying the system under head. This tank is fitted with an air-blown whistle, which sounds continuously when the oil level falls below a certain mark, thus calling the attention of the engineer to any failure in the oil service.

The grouping of all control mechanism on the top platform in full sight of the valve gear and full pump mechanism is, from the Diesel engineer's point of view, an advantage, but the arrangement is contrary to general marine usage, and we note that both Armstrongs and Sulzers are open-minded on this question and are prepared to fit auxiliary control on the lower platform if it be preferred. One advantage of the top platform arrangement is that it allows the engineer on duty full sight of the exhaust discharge in the daytime when the engine skylights are open. The exhaust gases from each cylinder may, however, be tested in another manner, by means of a test cock and pipe, which allows a portion of the exhaust to escape to the atmosphere, thus giving a guide to the working of each cylinder unit.

Accessibility has been carefully considered; thus the compressor valves may be examined and replaced whilst the engine is working by withdrawing a containing sleeve. The piston skirts may be inspected at all times through suitable doors.

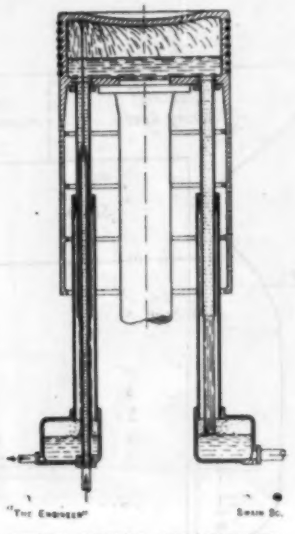
A useful provision is the arrangement of the mechanical device which operates the starting valve. This device is so constructed that it can be readily removed and examined, so that after an engine has been running for, say, twenty or thirty days with this mechanism unused the engineer may be certain on reaching port that his manœuvring gear is in good working order. All these points are small refinements, but nevertheless important for successful and easy manipulation and running.

A very complete service of auxiliary pumps and compressors is provided, both electrically and oil engine driven, so that complete stand-by units are available. The main engine service pumps and compressors are so rated that each is capable of running two main engines in case of breakdown. Two auxiliary

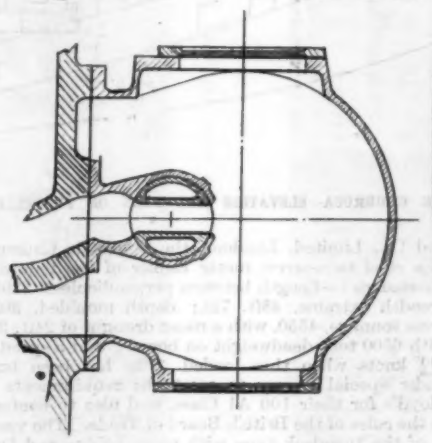



CONDE DE CHURRUCA—RESULTS OF TRIALS

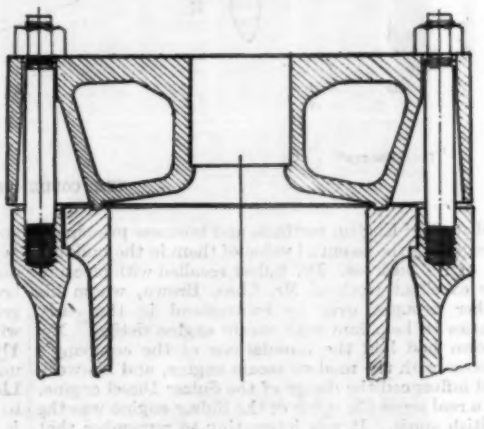
| | | |
|---|---|---|
| Duration of trial | 6.45 a.m. to 12.45 p.m. | |
| | Port. | Starboard. |
| Counter reading at beginning of trial | 152,347 | 18,268 |
| Counter reading at end of trial | 188,530 | 54,690 |
| Average revolutions per minute | 100.5 | 101.2 |
| Average brake horse-power | 1215 | 1245 |
| Total brake horse-power | 2460 | |
| Total fuel used | 716 gallons | |
| Exact time between fuel readings | 5 hours 55 min. | |
| Particulars of fuel | Shell-Mex gas oil, sp. gr. .873, flash point 169 deg. Fah. | |
| Total fuel used in pounds | 6250 lb. | |
| Fuel used by dynamo engines | 114 lb. | |
| Fuel used by main engines | 6136 lb. | |
| Fuel used by main engines | .421 lb. per B.H.P. hour | |
| | Port. | Starboard. |
| | Lb. per sq. in. | Lb. per sq. in. |
| Average pressure of injection air | 955 | 965 |
| Average readings of air compressor gauge— | | |
| High pressure | 955 | 965 |
| Intermediate pressure | 137 | 142 |
| Low pressure | 18 | 21 |




PISTON COOLING ARRANGEMENT




ROTARY SCAVENGE VALVE




CYLINDER COVER

generating sets are installed in the dynamo flat, each engine being of the two-cycle type, developing 70 kilowatts at 220 volts when running at 300 revolutions per minute. A small motor generator is provided to step down 230-volt current to 110 volts for deck and general lighting. The electrical equipment by the Metropolitan-Vickers and the switchboards are compactly and neatly arranged. In the wings of the engine-room a service workshop and store for spare parts are provided, the workshop being equipped with a motor driven lathe and drilling machine.

Two interesting auxiliaries are the Hele-Shaw electric steering gear, by Messrs. Hastie and Co., and the combined compressor and generator, by Sulzer Bros., shown in an illustration on page 298. The latter consists of a two-stage air compressor delivering air at 1200 lb. per square inch, driven by a 12 horse-power hand-started hot bulb engine, which is also coupled to an 8-kilowatt, 110-volt emergency generator.

The official trials of the ship were run on August 16th, and the results obtained, along with indicator cards taken, are here given.

The rating of these engines is very conservative, powers of 1550 brake horse-power being maintained at 108 revolutions per minute on recent tests.

Some figures may be given as regards the approximate weight of the installation. The two engines, complete with fly-wheels, pumps, and all fittings, weigh about 330 tons, which compares very favourably with four-stroke practice for similar powers. Even better figures can be given for the 1500 brake horse-power turbo scavenge type of engine, which, including thrust block and shaft scavenge pumps and motors, aggregates for the two engines a total weight of about 330 tons. Two of these engines are under construction at Stephens and Co., of Linthouse, Glasgow.

Both the engineers and shipbuilders may be proud of the Conde de Churruca, which has now entered the Mexican service of the Anglo-Saxon Petroleum Co., and whose performances will undoubtedly be watched with keen interest. The Sulzer engine has shown itself capable of effectively using Mexican crude oil on account of the super-port scavenging and the entire absence of exhaust valves. If the test performance can be maintained under lengthy sea service conditions, the Conde de Churruca will mark a step in advance.

## THE MACHINERY INDUSTRY OF GERMANY.

ACCORDING to a short report on the trade and industry of Essen, by Mr. R. P. F. Edwards, H.M. Vice-Consul in that town, the machinery making industry has not made such headway abroad as was hoped, owing to the depreciated value of the mark. The big armament factories which are now turning their attention to the manufacture of peace products, especially agricultural implements, find that the home market is dead. The complaint with regard to the agricultural industry is that the farmers will not purchase new machines, but prefer to keep on with the existing ones. There is no such scheme as the amalgamation of several small farmers, who might purchase one steam-driven machine to do the work of several farms.

The big factories do not consider that they will be on a satisfactory footing for the next three years. There have been several minor strikes, but nothing of any serious nature. There is a fairly large amount of short time work being done in the industry and some of the factories are working from 6 a.m. to 2.15 p.m., with one break of fifteen minutes. The directors complain that the work produced by working continuously in this way is unsatisfactory, as the eight hours is too long with a short break from 8.45 to 9 a.m., but the men insist on these hours.

## ELECTRICITY IN COAL MINES.

A CONFERENCE was recently held between the Switchgear Section of the British Electrical and Allied Manufacturers' Association and Mr. J. A. B. Horsley, H.M. Electrical Inspector of Mines, in connection with the rules governing the construction and use of switchboards in mines, Dr. Garrard, chairman of the Switchgear Technical Committee, being in the chair. As some of the matters for discussion also had their counterpart in the case of factory switchboards, H.M. Electrical Inspector of Factories, Mr. G. Scott Ram, was also invited to attend. After Mr. Ram had explained the bearing of the Factory Regulations on the points in question, Mr. Horsley dealt with the requirements of the Mines Rules and called attention to the information contained in "Mines and Quarries Form No. 11 (April, 1921)," which contains the electricity regulations and the revised official memorandum thereon.

After full discussion it was agreed to place on record the following views:—(1) *The Isolation of Circuit Breakers for Cleaning or Repairs.*—In colliery surface switchboards, when a switchboard circuit comprising air break circuit breakers or contactors cannot be shut down regularly, say, once a week, exclusive of Sundays, to permit of cleaning and adjustment being carried out with safety, means must be provided for isolating such circuit breakers or contactors. (2) *Screening.*—In view of the foregoing rule, provision for fixed or movable partitions may or may not be necessary, depending upon the nature and design of the switchboard. (3) *Insulating Barriers.*—When a switchboard has open type bus-bars arranged in the horizontal plane, insulating barriers must be fixed between them, projecting at least 2in. above the upper surface of the bus-bars. (4) *Shrouded Circuit Contacts.*—When a surface switchboard contains cut-outs having surface contacts fixed on the front, and the distance between opposite poles is less than 6in., such contacts must either be shrouded or protected by fillets provided between the poles.

# Notes on Water Power Development

ADDRESS BY PROFESSOR A. H. GIBSON, D.Sc., PRESIDENT OF SECTION G.*

(*Concluded from page 274.*)

*Scope for Future Water-power Development.*—The figures already quoted indicate that the scope for inland water-power development throughout the world, and more particularly throughout the British Empire, is likely to be large for many years to come, and it is gratifying to know that British engineers are prepared to play a large part in such development work.

The utilisation of this water power is likely to give rise to some economic problems of interest and importance. When industrial conditions have again become stabilised, the competitive ability of the various nations will depend largely on economy in the application of energy to production and transportation, and the possession of cheap water power is likely largely to counterbalance the possession of such resources as coal and iron as a measure of the industrial capacity of a nation.

While it is probably true in industrial communities that the most attractive water-power schemes have already received attention, many of those available in countries which have hitherto been non-industrial are capable of extremely cheap development and will certainly be utilised as soon as a market for their output can be assured.

It is in such countries that the result of these developments is likely to be most marked, and will require most careful consideration. Thus the hydro-electric survey of India now being carried out by the Indian Government indicates that very large water-power resources are available in the country, and that, although a few large schemes have been or are being developed, the resources of the country are practically untouched. There can be little doubt that in the course of time a large amount of cheap energy will be available in India for use in industrial processes, and as the country possesses a large and prolific population readily trained to mechanical and industrial processes, along with ample supplies of raw material for many such processes, all the conditions would appear to be favourable for its entry into the rank of manufacturing and industrial nations.

*Modern Tendencies in Water-power Development.*—The large amount of attention which has been concentrated on the various aspects of water-power development during the past ten years has been responsible for great modifications and improvements in the design, arrangement, and construction of the plant.

Broadly speaking, these have been in the direction of increasing the size, capacity, reliability, and efficiency of individual units; of improving the design of the turbine setting and of the head and tail works; of increasing the rotative speed of low head turbines; of detailed modifications in the reaction type of turbine to enable it to operate under higher heads than have hitherto been considered feasible; and of increasing the voltage utilised in transmission.

The capacity of individual units has been increased rapidly during recent years, and at the present time units having a maximum capacity of 55,000 horse-power under a head of 305ft. are being installed in the Queenston-Chippewa project at Niagara, while units of 100,000 horse-power are projected for an extension of the same plant.

These modern high-power turbines are usually of the vertical shaft, single runner type, with the weight of the shaft, runner, and generator carried from a single-thrust bearing of the Michell type. This type lends itself to a simple and efficient form of setting, while the friction losses in the turbine are extremely low. As a result of careful overall design it has been found possible to build units of this type having an efficiency of approximately 93 per cent.

One of the great drawbacks of the low head turbine in the past has been its relatively slow speed of rotation, which necessitated either a slow speed, and consequently costly generator, or expensive gearing. As a result of experiment it has, however, been possible so to modify the form of the runner as greatly to increase the speed of rotation under a given head without seriously reducing the efficiency.

Investigations in this direction are still in progress and promise to give rise to important results. At the present time, however, turbines are in existence which are capable of working efficiently at speeds at least five times as great as would have been thought feasible ten years ago.

The non-provision of a suitable pipe line has, until recent years, tended to retard the development of plants for very high heads. Under such heads the necessary wall thickness, even with a moderate pipe diameter, becomes too great to permit of the use of riveted joints. Recent developments in electric welding and oxy-acetylene welding have, however, rendered it possible to construct suitable welded pipes, and by their aid, and by the use of solid-drawn steel pipes in extreme cases, it has been found possible to harness some very high falls. The highest as yet utilised is at the Fully installation in Switzerland. Here the working head is 5412ft., corresponding to a working pressure of 2360 lb. per square inch. The pipe line is 19.7in. in diameter and 1¼in. thick at its lower end, and each of the three Pelton wheels in the power-house develops 3000 horse-power, with an efficiency of 82 per cent.

Until comparatively recently the Pelton wheel was looked upon as the only practicable turbine for high heads, and the use of the Francis turbine was restricted to heads below about 400ft. This was due partly to the fact that a reaction turbine of comparatively small dimensions gives a large output under a high head, and except in turbines of comparatively large power the water passages become very small and the friction losses in consequence large.

A further and more important reason for the general choice of the Pelton wheel for high heads was the fact that in the earlier Francis turbines, when operating under heads involving high speeds of water flow, corrosion of the runner was very serious. This corrosion is now generally attributed to the liberation of air containing nascent oxygen at points where eddy formation causes regions of low pressure. Careful design of the vanes has enabled this to be largely prevented in modern runners, and in consequence the field of useful application of the Francis turbine has been extended until at present turbines of this type are operating successfully under a head of 850ft., and this limit will probably be exceeded in the near future.

The great increase in all constructional costs since 1914 has increased the cost of the average hydro-electric plant by something of the order of 150 per cent., and since the cost of energy produced by such a plant is mainly due to fixed charges on the capital expenditure this cost has gone up in an even greater proportion owing to the higher interest charges now demanded.

It is true that the same increased cost applies within narrow limits to the output from every steam plant erected since the war, and the relative position of the two types of power plant with coal at about 25s. per ton is much the same as before the war.

The fact remains, however, that a newly constructed hydro-electric plant has often to compete in the market with a steam plant built in pre-war days whose standing charges are comparatively low, and in order to enable it to do so with success the constructional cost must often be reduced to a minimum compatible with safe and efficient operation. With this in view many modifications in design and construction have been introduced in recent plants, but there would still appear to be ample scope for investigation into the possibility of reducing the first cost by modifying many of the details of design and methods of construction now in common use.

Among recent modifications in this direction may be mentioned:—

1. The elimination of the dam in storage schemes in which natural lochs or reservoirs are utilised, this water level being drawn down in times of drought instead of being raised in times of flood. This reduces the cost of construction appreciably in favourable circumstances and eliminates the necessity for paying compensation for flooding of the land surrounding the reservoir.
2. The substitution, where feasible, of rockfill dams for those of masonry or monolithic concrete.
3. The introduction of outdoor installations with the minimum of power-house construction.
4. The simplification of the power plant.

Some progress has already been made in these directions, and it is probable that experience based on recent installations and experimental investigations will enable considerable further progress to be made.

*Research in Hydro-electric Problems.*—There are few branches of engineering in which research is more urgently required and in which it might be more directly useful.

Among the many questions still requiring investigation on the civil and mechanical side may be mentioned:—

1. *Turbines.*—Investigation of turbine corrosion as affected by the material and shape of the vanes.
   Effects of erosion due to sand and silt.
   Resistance to erosion offered by different materials and coatings.
   Bucket design in low head high-speed turbines.
   Draught tube design.
   Investigations of the directions and velocities of flow in modern types of high-speed turbines.
   Investigation of the degree of guidance as affected by the number of guide and runner vanes.
2. *Conduits and Pressure Tunnels.*—The design of large pipe lines under low heads with the view of reducing the weight of metal. The investigation of anti-corrosive coatings, so as to reduce the necessity for additional wall thickness to allow for corrosion.
   Methods of strengthening large thin-walled pipes against bending and against external pressures.
   Methods of lining open canals and of boring and lining pressure tunnels.
   Effects of curvature in a canal or tunnel.
3. *Dams.*—Most efficient methods of construction and best form of section especially for rockfill and earthen dams. Best methods of producing water-tightness.
4. *Run-off Data.*—Since the possibility of designing an installation to develop the available power efficiently and economically depends in many cases essentially on the accuracy of the run-off data available, the possession of accurate data extending over a long series of years is of great value.

While such data may be obtained either from stream gaugings or from rainfall and evaporation records, the former method is by far the more reliable. For a reasonable degree of accuracy, however, records must be available extending over a long period of years, and at the present moment such data are available only in very few cases.

Where accurate rainfall and evaporation records are available it is possible to obtain what is often a sufficiently close approximation to the run-off, but even rainfall records are not generally at hand where they are most required, and even in a district where such records are available they are usually confined to easily accessible points, and are seldom extended to the higher levels of a catchment area where the rainfall is greatest. Even throughout the United Kingdom our knowledge of the rainfall at elevations exceeding 500ft. is not satisfactory, and little definite is known concerning that at elevations exceeding 1000ft.

In this country evaporation may account for between 20 and 50 per cent. of the annual rainfall, depending on the physical characteristics of the site, its exposure, mean temperature, and the type of surface covering. In some countries evaporation may account for anything up to 100 per cent. of the rainfall. As yet, however, few records are available as to the effect of the many variables involved. An investigation devoted to the question of evaporation from water surfaces and from surfaces covered with bare soil and with various crops, under different conditions of wind, exposure, and mean temperature, would appear to be urgently needed. If this could be combined with an extension of Vermeulle's investigation into the relationship between rainfall, evaporation, and run-off on watersheds of a few characteristic types, it

* British Association, Edinburgh.

would do much towards enabling an accurate estimate of the water power possibilities of any given site to be predetermined.

Even more useful results would follow the initiation of a systematic scheme of gauging applied to all streams affording potential power sites.

Among other questions which are ripe for investigation may be mentioned :—

1. The combined operation of steam and water power plants to give maximum all-round efficiency.
2. The relative advantages of high-voltage direct-current and alternating-current generation and transmission for short distances.
3. The operation of automatic and semi-automatic generating stations.

*Tidal Power.*—The question of tidal power has received much attention during the last few years. In this country it has been considered by the Water Power Resources Committee of the Board of Trade, which has issued a special tidal power report dealing more particularly with a suggested scheme on the Severn. The outline of a specific scheme on the same estuary was published by the Ministry of Transport towards the end of 1920.

In France a special commission has been appointed by the Ministry of Public Works to consider the development of tidal power, and it has been decided to erect a 3000-kilowatt experimental plant on the coast of Brittany. With the view of encouraging research the Government proposes to grant concessions, where required, for the laying down of additional installations.

The tidal rise and fall around our coasts represents an enormous amount of energy, as may be exemplified by the fact that the power obtainable from the suggested Severn installation alone, for a period of eight hours daily throughout the year, would be of the order of 450,000 horse-power.

Many suggestions for utilising the tides by the use of current motors, float-operated air compressors, and the like, have been made, but the only practicable means of utilising tidal energy on any large scale would appear to involve the provision of one or more dams, impounding the water in tidal basins, and the use of the impounded water to drive turbines.

The energy thus rendered available is, however, intermittent ; the average working head is low and varies daily within very wide limits, while the maximum daily output varies widely as between spring and neap tides.

If some electro-chemical or electro-physical process were available, capable of utilising an intermittent energy supply subject to variations of this kind, the value of tidal power would be greatly increased. At the moment, however, no such process is commercially available, and in order to utilise any isolated tidal scheme for normal industrial application it is necessary to provide means for converting the variable output into a continuous supply constant throughout the normal working period.

Various schemes have been suggested for obtaining a continuous output by the co-ordinated operation of two or more tidal basins separated from each other and from the sea by dams with appropriate sluice gates. This method, however, can only get over the difficulty of equalising the outputs of spring and neap tides if it be arranged that the maximum rate of output is that governed by the working head at the lowest neap tide, in which case only a small fraction of the available energy is utilised.

When a single tidal basin is used it is necessary to provide some storage system to absorb a portion of the energy during the daily and fortnightly periods of maximum output, and for this purpose the most promising method at the moment appears to involve the use of an auxiliary high-level reservoir into which water is pumped when excess energy is available, to be used to drive secondary turbines as required. It is, however, possible that better methods may be devised. Storage by the use of electrically heated boilers has been suggested, and the whole field of storage is one which would probably well repay investigation.

If a sufficiently extensive electrical network were available, linking up a number of large steam and inland water power stations, a tidal power scheme might readily be connected into such a network without any storage being necessary, and this would appear to be a possibility which should not be overlooked in the case of our own country.

*Investigation Necessary.*—A tidal power project on any large scale involves a number of special problems for the satisfactory solution of which our present data are inadequate.

Thus the effect of a barrage on the silting of a large estuary, and the exact effect on the level in the estuary and in the tidal basin at any given time, can only be determined by experiment, either on a small installation or preferably on a model of the large scheme.

Many of the hydraulic, mechanical, and electrical problems involved are comparatively new, and there is little practical experience to serve as a basis of their solution.

Among these may be mentioned :—

1. The most advantageous cycle of operations as regards working periods, mean head, and variations of head.
2. The methods of control and of sluice gate operation.
3. Effect of changes of level due to wind or waves.
4. The best form of turbine and setting and the most economical turbine capacity.
5. The possibilities of undue corrosion of turbine parts in salt water.
6. The best method of operation ; constant or variable speed.
7. Whether the generators shall be geared or direct driven.
8. Whether generation shall be by direct or alternating current.

The questions of interference with navigation and with fisheries, of utilising the dam for rail or road transport across the estuary, and, above all, economic questions connected with the cost of production, and the disposal of the output of such an installation, also require the most careful consideration before a scheme of any magnitude can be embarked upon with assurance of success.

In view of the magnitude of the interests involved and of the fact that rough preliminary estimates indicate that to-day current even for an ordinary industrial load could be supplied from such an installation at a price lower than from a steam generating station giving the same output with coal at its present price, it would appear desirable that these problems should receive adequate investigation at an early date.

*Facilities for Research in Hydraulic and Cognate Problems.*—In view of the considerations already outlined, and especially in view of the large part which British engineering will probably play in future water power developments, the provision on an adequate scale at some institution in this country of facilities for research on hydraulic and cognate problems connected with the development of water power is worthy of serious attention.

At present the subject is treated in the curriculum of the engineering schools of one or two of our universities, but in no case is the laboratory equipment really adequate for the purpose in question.

What is required is a research laboratory with facilities for experiments on the flow of water on a fairly large scale ; for carrying out turbine tests on models of sufficient capacity to serve as a basis for design ; and, if possible, working in conjunction with one or more of the hydro-electric stations already in existence, or to be installed in the country, at which certain large-scale work might be carried out.

The provision of such a laboratory is at the moment under consideration in the United States, and in view of the rapidity with which the designs of hydraulic prime movers and their accessories are being improved at the moment, it would appear most desirable that the British designer, in order that the deservedly high status of his products should be maintained and enhanced, should at least have access to equal facilities, and should, if necessary, be able to submit any outstanding problems to investigation by a specially trained staff.

The extent to which our various heat engine laboratories have been able of recent years to assist in the development of the internal combustion engine, and to which our experimental tanks have assisted in the development of the shipbuilding industry, is well known to most of us, and the provision of similar facilities to assist in the development of our hydro-electric industry would probably have equally good results in this connection.

As a result of representations made by the Water Power Committee of the Board of Trade, I understand that it has now been decided to initiate a Chair of Hydro-electric Engineering in some one university, and it is greatly to be hoped that funds may be available to enable the necessary laboratory to be designed and equipped on a scale commensurate with the importance of the work which it would be required to undertake.

## Provincial Letters.

### THE MIDLANDS AND STAFFORDSHIRE.

*(From our own Correspondent.)*

#### Pig Iron Down and Down.

FOUNDRY pig iron continues to fall rapidly, and numerous makers are now willing to take almost any prices within reason that they can get buyers to offer. This week's Midland prices, compared with two or three weeks back, show a fall of fully 30s. a ton. A fortnight or so ago, £8 per ton was the general price mentioned on the Birmingham market for No. 3 foundry iron. To-day Northampton smelters are said to be willing to deliver in Birmingham at £6 10s., consumers being assured of delivery in a few weeks. Derbyshire No. 3 cannot command more than 10s. more, making the figure for these brands £7 to £7 5s., and when sellers are asked this week whether this figure includes delivery, the answer varies according to the individual disposition of smelters and position of order books. £6 10s. as the price named for Northampton foundry iron delivered Birmingham is about equivalent to to-day's quotation for Belgian foundry iron delivered. Even so large a concession as this, however, fails to arouse much enthusiasm from buyers. With the foundry market in its present smitten condition, quotations for forge iron are quite nominal and impossible to fix, though some Derbyshire makers are understood to be quoting something round £6 10s. Staffordshire pig irons are almost entirely off the market, there being no production, and the only safe quotation that is at all possible at date is all-mine cold blast iron, which is employed for best foundry mixtures at £17 to £17 7s. 6d. per ton. Pig iron prices now approximate so closely to those of imported iron that users are, happily, now ready to buy from home firms. The demand is, however, generally very poor. Supplies from the Continent are said to be approaching the vanishing point, though there is still a fair amount of iron at low prices coming in from France and Luxembourg. No further blowing in of blast-furnaces in Staffordshire can be recorded. There are expectations that there will be a re-start of certain furnaces in the Darlaston district as the result of negotiations which are believed to be going on with regard to a well-known firm. There is some talk of re-opening furnaces at Wellingborough. The Northamptonshire furnaces, the re-starting of which was referred to last week, will not for the present be making basic iron for the firm with which the owners have recently amalgamated, but will be producing forge and foundry iron for the market.

#### Beating the Belgian Smelters.

Midland smelters appear to have arrived at the conclusion that the time has now come to strike vigorously for the recovery of British independence, hence the 30s. drop in pig iron recorded above. During this year the high cost of fuel and other raw materials and the inflation of wages have left us helpless in face of the lower standard prevailing among our competitors, as expressed in the rates of exchange. The shutting down of our blast-furnaces has been the most sinister feature of the trade depression. It has meant not only that we have sent abroad an enormous amount of money for raw material while our own plants and labour have been consuming without earning, but that the whole economy of the iron and steel industry has been thrown out of gear. Price reductions are the order of the day, and the disparity between continental and native prices is rapidly vanishing. With his materials at reasonable and competitive prices, the British iron and steel master will have nothing to fear from his continental rivals, and will gradually re-establish himself again in both the home and export markets.

#### Iron Gas Tube Strip Reduced.

The demand for iron gas strip of late has been so small that makers last week cut their prices by £2 10s. per ton in order to secure, if possible, a little of the business which has been going to the steel makers. The fall was from £20 to £17 10s., which still leaves a margin of £5 in favour of steel tube strip, which is now quoted at £12 10s. to £13 10s. per ton. Business in the manufactured iron trade generally remains quiet. The marked bar mills are a bright exception, inasmuch as they have plenty of work still on hand. Truly theirs is largely a monopoly industry, but the fact remains that they are well employed. The quotation for high grade bars is upheld at £20. In the common bar branch conditions are by no means so rosy, nor can it be said that the immediate outlook is promising. The depression in the nut and bolt and fencing trade is a primary factor. The tendency is to confine operations in the nut and bolt works to a couple of days a week. Some of them have been going three days, but others are chary about further increasing stocks for which there is no immediate market. There is an occasional gleam of sunshine in the shape of an order sufficient to keep some particular establishment employed for a full week, but there is no continuity. Similarly, in the fencing trade, iron at £16 does not permit of the construction of a lot of fencing made from that metal, and wire is used. The iron and steel tube trade, which forms so important an element in Midland industry, is doing better. Galvanised sheet makers are finding a decided improvement in the home demand, whilst the export business also has improved of late, though only slightly. The mills are, however, by no means working anything like full time.

#### £3 Drop in Steel Hoops.

Steel manufacturers continue to make a determined effort, by drastic price reductions, to check the domination of the foreigner, and following upon the price cuts of a fortnight ago, a further reduction in the price of steel hoops has been announced. This shows a cut of £3 per ton, bringing the price down from £17 per ton to £14. The bold tactics of some billet makers seem to have met with considerable success and to have given them control of the market again. It is stated in Birmingham that one well-known house in the Principality, which was quoting £7 10s. last week for soft billets, has closed its books, having sold the output for months to come. The price named cannot be said to be representative, but British makers are re-asserting their predominance in the home market. Generally speaking, continental prices for steel are stiffening, and early deliveries cannot be depended upon. It is reported that for some classes of imported steel 10s. more per ton is being paid than applied a few weeks ago. Continental iron and steel generally are not being imported on so disquieting a scale as formerly. This is said to be due to several causes, one of them being the wide fluctuations of the exchange rate. The hazards involved restrain both buyers and sellers. Another cause is that works managements which have been carrying on at reduced speed with the aid of continental raw material were tempted by the disparity between British and foreign prices in the first half of the year to overdo the importations. With a declining demand for their finished goods their purchases of crude and semi-manufactured iron and steel have hung heavily on their hands. More important than all, there is a prospect of being able to buy at home once more on terms which will enable a great many departments of manufacture to throw off the foreign yoke. The South Staffordshire steel works are little better off for orders than three weeks ago, though inquiries show a tendency to increase. Short time is the rule, and orders bring no profit, and in some cases a serious loss. The cut made in prices last week has not yet had any appreciable effect on the volume of business forthcoming. Improvement is, however, noticeable, chiefly in the demand for billets and sheet bars, and is welcome as indicating an increase in the activity of the local mills.

#### Wire and Wire Rods.

The prices of tinned mattress wire in Birmingham have been revised, and are now on the basis of £44 per ton as against £46 10s. hitherto. The reduction applies also to tinned bottle wire and tinned stitching wire. A new list for cut wire is based on £20, with the old list extras for cutting. Buyers are still dissatisfied, and it is apparent that prices have still a long way to fall before they will meet with their approval. A large quantity of German wire rods has been offered at £8 15s. f.o.b. Antwerp, a price which, after allowing for transport, shows a considerable advantage over the home quotation of £13 5s.

#### Constructional Engineering.

No substantial improvement in constructional engineering business is looked for until the spring. The railway companies show great reluctance in entering upon new schemes, and generally the times are unfavourable to the placing of large contracts. Staffordshire steel firms which lay themselves out for steel for constructional work are poorly employed, contracts being nearly all of a trifling character.

#### Fuel.

There appears to be considerable activity in hunting up orders on the part of Midland coal firms, and manufacturers are being offered fuel at rates which, as a body, they maintain they are unable to discuss. The falling tendency appears, however, to continue. Double screen nuts are available at 30s. per ton, and forge coal is quoted 26s. per ton. The opinion is expressed that the prices of industrial fuel must be further brought down by at least 15s. per ton. if industry is to become normally employed.

**Unemployment.**

The latest unemployment statistics for the West Midlands show a decrease of 4000, the total now standing at 179,211. The figures for the nineteen big towns in the area show an almost uniform decrease, the only exceptions being Cradley Heath and Longton, where the number of registered unemployed increased. Important schemes are under consideration by the Birmingham City Council and the Birmingham Board of Guardians for the relief of unemployment during the autumn and winter. Evidence multiplies, unfortunately, that there will be much unemployment in the city. The Ministry of Labour figures certainly lately have shown considerable decreases in the number of unemployed, but the improvement is more apparent than real. Large numbers of persons pass off the register, although they have not secured employment. The schemes suggested include one of road construction, involving an expenditure of £120,000. A further scheme comprises road widening, estimated to cost £225,000, reconstruction of surfaces £280,000, and sewers £76,000. These are all works which will be needed at an early date, but, of course, require the sanction of the City Council on account of the expenditure. The proposed Birmingham-Wolverhampton road has been mentioned as an excellent scheme for the relief of unemployment in the Midlands area, and it has been agreed to ask the General Purposes Committee of the Birmingham Corporation to approach the Government in the light of the present need for assistance in this project.

**Coventry Engineers More Hopeful.**

There is little, if any, change in the trade position in Coventry, and despite a further decrease of 205 persons totally unemployed and of 133 fewer on short time, manufacturers generally do not regard the immediate future at all hopefully. The result of the impending deliberations on the question of the Churchill award is awaited with some anxiety, but it is recognised that this is but one point in the complex question of how to re-establish export trade, which plays such an important part in the trade of the city. Among the heavy engineering firms, although no concrete improvement can be instanced, a slightly more hopeful tone is noticeable in some quarters where employers see a glimmering of light in the more favourable reports from the iron and steel centres.

## LANCASHIRE.

*(From our own Correspondents.)*

MANCHESTER, Thursday.

**Iron, Steel and Metals.**

THE markets for iron, steel and metals move very slowly; indeed, so slowly that it is difficult to believe that they change at all. Prices alter a little, of course, but no ascertainable change comes to the general conditions. The price alterations in the raw metals are mainly of a speculative nature and quite ephemeral. It is a solid change in conditions that is wanted and for which we are waiting. One thing is certain, namely, that a great cheapening of all production is necessary before trade can be put upon a safe basis. The world is poor, and it is useless to try to maintain high prices and high wages in a poor world. Things must be made cheaply or consumers cannot buy them; and this applies to machinery just as much as to clothing or to food. Germany is making things cheaply, and Germany is fast recovering her industrial life, and we have to follow in the same direction if we also are to recover our position.

**Metals.**

The slight upward movement in the copper market seems to have come to an end for the present, and as it was not supported by any improvement in trade conditions, this was only to be expected. There may, of course, be mad speculative movements like that which has just afflicted the cotton trade, but these do far more harm than good, for a speculative movement is particularly damaging when there is no improvement of trade behind it. Perhaps some rather better buying of copper has been seen on the Continent, not altogether confined to Germany; but in this country one finds no trace of improved buying of copper or any of the other metals. The slight rise in the price of standard copper induced makers of copper sheets to raise the price by £2 to £103 per ton. This policy cannot, however, be commended, because the difference between raw copper and sheets was already far too great. There are evidently symptoms of profound discontent with the prices for manufactured copper and brass, and it would be certainly wise on the part of manufacturers to give heed to these symptoms. The engineering industry certainly wants all the help it can get from moderate prices, and it is already handicapped very severely by the fact that the cost of iron and steel is so much greater here than it is in America or on the continent of Europe. All such engineering material as copper and brass manufactures should be supplied to engineers at the lowest prices possible, consistent with a fair working profit for the manufacturer. Electrolytic ingot copper has been a little easier, but, of course, the improvement in the American exchange tends to ease American prices on this side. Apart from this influence, there is as yet very little change in the position. The rise in tin, which carried the price above £160 from the level of £150, has met with the same check as in the case of copper, and probably for the same reason. As there is no sufficient trade demand for copper, so there is none for tin, and, indeed, the consumptive demand for tin is checked also by the dulness of the tin-plate trade. South Wales buyers are taking far less than their usual quantity, and it is obvious from the import figures of the American returns that this trade in America is not what it promised to be. Probably the truth is that the grossly excessive prices for all tinned provisions have reduced that industry very much; and it will take a considerable period of moderate prices to bring it back to the old prosperity. At any rate, the demand for tin-plate is small, and the tin market does not revive without it. The prices may keep for some time between £150 and £160 per ton, for these are fairly low figures; but for any serious advance in the market a better consumptive trade is wanted. The price of lead keeps very steady, and there is practically no change in the general situation. Consumers do not seem in any hurry to buy, although it is generally believed that their stocks are low. They seem to be content to buy small lots as the metal is wanted, and to leave the trade to do the bulk of the holding of stocks. In spelter there is no change, and the market is dull.

**Pig Iron.**

The great irregularities in the pig iron market still persist, and there is no doubt that they have a very bad effect on the minds of buyers. No one, for instance, can believe that 135s. is a reasonable price for Cleveland No. 3 when Cleveland No. 4 is offered at 115s.; or that 170s. is a reasonable price for Scotch No. 3 when hematite is offered at 145s. Something ought to be done at once to get these prices into some sort of order. The demand in Manchester for forge pig iron seems to be absent; but there is still a small demand for foundry pig, although this is diminishing. One thing is very clear, and that is that if all the furnaces of the kingdom were started there would soon be an overwhelming superfluity of pig iron on the market. The furnaces which are occasionally started are probably no sign of any improvement in trade, but an indication that owners believe they will lose less by working than by remaining idle. The price of Derbyshire No. 3 foundry iron here seems to be a little easier; but there is not much change, and it is not likely that any concessions in price would lead to much buying until the foundries can renew their supply of orders for castings.

**Finished Material.**

In the market for manufactured steel there is very little change at present, except that the pressure of competition from the Continent is less than it was. No doubt the French and Belgian works still want orders, but they are encouraged to try for higher prices by the fact that Germany is not able to accept any more prompt orders. German steel bars, for instance, are now quoted up to £9 f.o.b., or £1 more than the lowest price.

**Scrap.**

The market for foundry scrap is still very quiet, and the prices are now inclined to sag, although those for the qualities which can be used in the place of Scotch iron keep up. The truth is that the rumour of the break up of the pig iron association in the Midlands, although not confirmed on the Manchester exchange yet, made holders of cast scrap nervous about the result to the pig iron prices, and the fact that Cleveland iron for delivery next month was offered quite freely at £6 on trucks also added to the feeling of nervousness. Probably good scrap could have been bought in Manchester on Tuesday at under £6. In the other departments of the scrap market there is no change.

**The Engineering Trades.**

Although there is no material improvement observable in the local engineering industry, there is a slightly more optimistic feeling abroad that we are now at about the bottom of the period of depression, and that any change which may take place must be for the better. It is perhaps too much to expect any material improvement in the export trade until there is a decided change in the financial situation. The depreciation of the mark is no doubt the cause of many orders for machinery being secured by German engineers. An instance has recently come to my knowledge of orders for certain plant for South America going to the Germans which in normal circumstances would have been placed in this country. These orders have been lost to us purely on account of the enormous difference in the prices quoted, and the question to be answered is how long will our foreign competitors be able to continue taking orders at prices which British engineers are unable to approach? An engineer friend who has recently been on a visit to Germany, and who has had access to some of the works in that country, informs me that, in spite of the low prices, these works are not working at anything like their full capacity. The hours of labour are quite as short as those in normal times here, and the output per man-hour is no greater than at home. It would seem, therefore, that there is not much likelihood of British engineers being able to compete for foreign trade with the Germans for some time to come. On the other hand, there is good reason to believe that a revival in the home trade can be brought about by a drastic cutting of prices, which will shortly be possible if the workers accept a further reduction in wages. It is quite certain that a large amount of business is being held up pending this event, and it is sincerely to be hoped that this business will not have to be given to our foreign competitors.

**Mid-Lancashire Joint Electricity Scheme.**

The conference of local authorities which has just been held at Preston to consider the above-named scheme has adjourned indefinitely. The scheme involves three large generating stations costing several millions of pounds, and the districts interested include Blackburn, Preston, Accrington, Bacup, Colne, Darwen, Haslingden, Nelson, Rawtenstall, Fleetwood, Lytham and St. Annes-on-Sea.

**Manchester Association of Engineers.**

The new students' section of the above-named association is, I am informed, making very good progress, over 120 members having already been enrolled. The object of the section, to which allusion has previously been made in this column, is to enable engineering trade apprentices and students to extend their general knowledge of the various branches of engineering, as well as to provide them with opportunities for the making of social friendships and acquiring powers of expression by the reading of papers and taking part in discussions. It is the intention of the Council that this section shall eventually be managed by a committee elected by and from its own members, with the exception of the chairman and vice-chairman, who will be elected by the Council of the Association. For the opening session, commencing next month, in order to initiate the section and give time for the students to organise themselves, the Council has arranged a programme which will include a reception and address by Mr. Henry Pilling, ex-president, and lectures on coal, hydraulic turbines, metals, petroleum, coal gas, electricity, draughtsmanship and jigs, by the following gentlemen:—Capt. Sinnatt, Professor A. H. Gibson, Mr. W. E. W. Millington, Mr. Harold Moore, Mr. W. E. Buckley, Mr. Julius Frith, Mr. I. H. Wright, and Mr. T. Elliott. The meetings will be held generally on the first and third Thursday evenings of the months October to March inclusive, in the chemical laboratory at the College of Technology. I understand that an excellent batch of papers has been got together for reading before the senior section of the Association during the coming session, under the presidency of Alderman F. West, and that the Council has decided that in future the meetings are to be held on Friday instead of Saturday evenings—a step which will meet with the cordial approval of a large majority of the members.

BARROW-IN-FURNESS, Thursday.

**Hematites.**

The depression in the hematite pig iron trade of North Lancashire and Cumberland is slow in showing much improvement. It is true that there is a certain amount of iron being produced, but the total tonnage is not great. At present there are furnaces in operation at Ulverston, Cleator Moor, Millom and Workington, and by Monday next a furnace will be in blast at Barrow. The output is on account of metal urgently wanted, and there are no signs yet of a general resumption, and there cannot be until prices are brought down to a level that will induce buyers to come forward with their orders. Last week there was a further cut to the amount of 10s., and although that is all to the good, there is yet a big margin of difference between smelters' ideas and those of consumers. Raw materials keep at a high figure, and there is an outstanding difficulty on the wages question with regard to the Cumberland iron ore miners, a new basis of calculation being demanded by the mine owners. The Furness miners agreed some time ago to this new basis.

**Iron Ore.**

There is just a little more activity in the iron mining trade of North Lancashire. On Monday, the Pennington pit in the Lindal Moor district was re-started with fifty men. At the Roanhead mines, near Barrow, a fair number of men are engaged on short time. The ore is used at Ulverston.

**Steel.**

Whilst at Workington the rail mills are in operation and some other smaller departments, there is no activity at Barrow in the steel-producing plant. No start will be made until there is an improvement in the general conditions. Hoops have been rolled at a branch of the Barrow Steel Company's works, but otherwise there is idleness. The demand for steel is very poor, and prospects are not cheering at the moment.

**Shipbuilding and Engineering.**

In the shipbuilding trade there is a fair amount of activity, and many of the men at the Barrow shipyard are on full time, but short time is the rule throughout the engineering shops.

## SHEFFIELD.

*(From our own Correspondent.)*

**New Work and Repairs.**

THIS week I have been chatting with a steel manufacturer who thinks I take a too optimistic view of the trade position and outlook. My letters may be written in an optimistic spirit—and always will be, let us hope—but the intention certainly is to present both sides of the case, and there is, of course, very little encouragement if one looks in some directions. My friend admitted, in conversation, that orders are increasing, but urged that more consideration should be given to the character of the orders. His point was this: There are two kinds of orders—for new work and for repairs. Now, he said, what most steel firms are getting are orders of the latter kind. Then he proceeded to prove his contention. Where is there new work in any important quantity? he asked. The housing schemes, which would have called for light iron and steel castings, steel girders and quantities of tools of one kind or another, are nearly all suspended. The home railways, from whom large contracts had been expected, hardly know yet what their requirements will be under the new grouping system, which naturally lends itself to great economies in the matter of rolling stock. The mercantile shipyards are without new work, chiefly in consequence of the fact that through the "ship for ship" reparations demand, and for other reasons, there is far more available tonnage than our freights are likely to absorb for a long time to come. Those two items alone—railway and shipbuilding steel—are sufficient to make trade in the Sheffield district prosperous or the opposite. Then, he added, what immediate hope is there of any substantial revival in motor vehicle construction? Yet of late years some of the Sheffield firms have been doing a very large business in the production of castings and forgings and other steels for automobile construction. A lot has been said about the new battle-cruisers that are to be laid down at some indefinite date, but it is doubtful if the Government has really got through the talking stage yet. It certainly cannot be more than conjecture that the first four of these vessels have been allocated to certain yards, for the Government's invariable policy is to call for tenders, and so far as I know that has not yet been done.

**No Recovery Yet?**

Thus he argued away the outlook for new work

for the steel firms so far as the home market was concerned, and when he turned to the foreign markets his view was no more inspiring. In the old days, he went on, we were always pretty sure of securing some big overseas contracts because we used to lend various countries the money with which to buy the things from us. Now we have not the money to lend, and even if we had, few of the countries with which we used to deal have any credit worth speaking of, beside which the level of the exchange rates makes it a costly matter for most of them to place orders in this country. "No," he concluded, lugubriously, "it must be a good time yet before conditions justify anyone speaking of a trade recovery. It will come, of course, but not this year, and not until 1922 has got well into its stride. You will hear of contracts being secured here and there, with or without a profit margin, but one or two swallows never yet made a summer. The only thing that is happening just now is a rather big increase in repair work of all kinds in iron and steel, calling for a certain quantity of forgings, castings and so on, and that is caused principally through the overhauling and supplementing of machinery and plant in various industrial centres in preparation for trade which, it is hoped, will materialise presently. There is, of course, a small amount of new work coming forward, and there remains in the hands of some steel firms a fair quantity of old contracts about the execution of which there may not be any great hurry. That is about as far as I see the situation."

### Difficult to Judge.

Because of the standing of the manufacturer whose opinions are thus given, one is compelled to pay a great deal of regard to the views expressed, though they leave little room for optimism apparently. Yet he is far from being a pessimist in the ordinary way. What he says, however, seems to take no cognisance of the numerous and considerable orders which keep passing us in favour of one of the continental countries where costs of production are known to be much lower than ours, apart from the question of adverse exchange rates; and in any case I shall continue to pin my faith to a belief in a pretty rapid recovery of trade as soon as ever production costs have been got down to something within reason. The position truly is as difficult as ever to judge accurately. It is full of contradictions. For example, I had occasion, an hour or so before writing this, to speak with a very well-known firm here regarding an inquiry received for certain steel material, and was told point blank that the works were doing nothing. Nevertheless, a very short time previously another Sheffield steel firm rang me up specially to say that, in spite of all the depression in the crucible steel industry, its recently completed works—the Ivanhoe works of Henry Rossell and Company—were running twenty-four hours a day on crucible steel, and I have heard indirectly that the Park Gate Iron and Steel Company's works at Rotherham are as busy as they can be rolling sheets, girders and other constructional steel. Then I learn of large consignments of steel for Spain, of a fair quantity of railway tires for South Africa, and of a firm of circular and other saw makers hardly knowing which way to turn to get stuff out. A great deal more, of course, could be said for and against, but perhaps what is written will be accepted as an indication of how things actually are. That the position is not too good is clear from the very gradual manner in which the army of unemployed is being absorbed, and it is not hard to believe that the close of the year will be upon us before the ranks of the enforced idle have been reduced to fairly normal proportions.

### Fuel and Iron Prices.

One thing is quite plain—too much emphasis cannot be laid on the necessity for cheaper fuel, because with that the iron furnaces can be got into operation again and we will be able to supply our steel furnaces with home-produced pig iron instead of having to go to the Continent for it, as the case is at present. The Park Gate concern, for instance, with its costly blast-furnace plant, is being compelled to buy pig iron from Belgium which could be made at home if it were economically possible to do so. The question is—When would that point be reached? Well, colliery sidings and wagons are simply glutted with small fuels, and coking slacks, which not long ago commanded anything up to 25s. or 35s., are now down to rather less than pre-war prices, viz., 5s. to 8s. a ton at pits, though some people still put the figure at a considerably higher level. The price of blast-furnace coke, however, remains at 30s. down to about 25s. at ovens. Very serviceable pig iron—not as good as one would like, but all right for general purposes—is being offered from Belgium, delivered Sheffield, at from £5 5s. down to £5 2s. 6d. For Derbyshire or Yorkshire makers to produce pig iron at that price coke would have to be reduced to a figure certainly not higher than 15s. a ton at ovens; in fact, nearer 12s. It will be seen, therefore, that a good deal of leeway has to be made up yet. But it was not very long before the war that blast-furnace coke was down to as low as 8s. to 9s. a ton, compared with from 65s. to 80s. at the height of war conditions, and it is since the dawn of the present century that thousands of tons of slacks suitable for coking purposes changed hands down to eighteen pence a ton. Carters want more than that now for conveying a load of cinder refuse from a works to a public "tip"—and get it, too! There is a little buying of West Coast hematite proceeding, I believe, which, by the way, looks as if some Sheffield firms, at least, are making high-class open-hearth steel, as, of course, they are doing, and the buying movement may receive encouragement from the fact that this make of iron has been reduced to about £7 5s. at works, or £7 15s. delivered in the Sheffield area. The reduction that has occurred since the Armistice may be judged when it is recalled that the war-time peak was £16 or more, but that values have a good way to travel downwards yet is equally clear by the fact that the pre-war price of West Coast hematite was about £3 or £4 for mixed numbers.

### Coke Oven Developments.

Speaking of coking coal, it would be rather interesting to know the present-day proportion of beehive ovens to the patent coke ovens. I remember a short time before the war making some calculations which seemed to place the proportion of the old beehive type at about 40 per cent., but nowadays it is doubtful if the number in existence would represent more than 20 per cent. of the whole of the coke ovens, and it is extremely doubtful whether more than a very small number of these will ever be lighted up again. In view of the valuable by-products resulting from the operation of the patent ovens, the old style must be regarded as wickedly wasteful and having no part or lot in a so-called age of economy. Some of the iron furnace men steadily refused to run the furnaces with anything else than beehive coke, but it is a question if even their prejudices have outlived the war. Certainly in the last decade enormous numbers of patent coke ovens have been installed up and down the country. The Koppers Coke Oven Company—which nowadays, I understand, is an all-British concern and has its headquarters in Sheffield—had just completed a battery of 100 ovens from the Ebbw Vale Iron, Steel and Coal Company when the war broke out, and during hostilities a further battery of fifty ovens was added. Now the Koppers people tell me they have just completed a £300,000 contract for the installation of another battery of 100 ovens, making 250 altogether. In a recent letter I think I mentioned that the directors of the United Steel Companies, Limited, were doing something of the same kind at their Rother Vale collieries at Orgreave, near Sheffield. An installation of two batteries of Koppers ovens, fifty-four in each, has just been completed. The ovens are not as large as those at Ebbw Vale, but they have a distinctiveness of their own, being of the combination type, which, the makers believe, will prove to be the oven of the future. They can be heated by means of their own gas or by producer gas made, where possible, from inferior fuel. About 50 or 60 per cent. of the gas from these ovens will be available as surplus, and will be conveyed through pipe lines, already laid down, to the mains of the Sheffield Gas Company, to be used for lighting and heating purposes. The 108 ovens will have a carbonising capacity of 5000 tons of coal a week. The contract includes a tar distillation plant and a benzol rectification plant, beside a by-product plant of the Koppers design.

### Colliery Interests Awakening.

In addition to the Ebbw Vale and Sheffield installations, thirty Koppers coke ovens have just been completed for the Dinnington Main collieries—one of the Sheepbridge group—having been put down in replacement of twenty-five ovens of an older type, the new battery being connected up with the existing by-product plant. Then thirty-six ovens of the same design have been erected at the Barnsley Main colliery, and I hear the Powell Duffryn people have had a battery of fifty installed on their property, where, it may be interesting to mention, the Koppers Company put down one of its very first ovens. The British Tar Products Company is installing a special distillation plant of the Sheffield company's design. A point which seems to me to be of special interest is the awakening of colliery concerns to the value of the ovens from the by-product aspect. Up to recently most of them installed only the crude plants, but now they are adding tar distillation and benzol rectification plants. But with all this forward movement a large number of coke oven plants can scarcely be called up to date any more than can the majority of the blast-furnaces in which the coke is used. A friend recently returned from the States tells me that there few of the blast-furnaces have an output of less than 500 tons a day. Have we any in this country with such a capacity? Very few, I should say, if any.

## NORTH OF ENGLAND.

*(From our own Correspondent.)*

### Hopes of Trade Revival.

ALTHOUGH it cannot yet be said that there is any real or definite expansion in trade generally in the North of England, there are not wanting signs that the dark clouds of depression which have enshrouded the industrial horizon for many months past are gradually lifting and giving way to a much better atmosphere. The process of re-starting the wheels of industry since the disastrous miners' strike has, admittedly, been disappointingly slow; but the progress made during the past two or three weeks has been much more encouraging, and the general tendency is towards further improvement in this respect. Some considerable time must certainly elapse before there can be anything like a return to normal working conditions, but there is undoubtedly a greater note of confidence as to an earlier recovery of industry than prevailed a few weeks ago. The great problem at the moment is to reduce costs of production to a level which will enable manufacturers to sell at a competitive price both in the home and foreign markets. Even yet, substantial as has been the fall in coal prices, they are still too high to permit of a general resumption of the iron and steel industry. In the meantime the export trade in pig iron in this area is almost lifeless, and foreign iron continues to be imported at prices well below our cost of production. Last month, for example, only 1381 tons of pig iron were shipped abroad from the Cleveland district, whereas 12,302 tons were brought into the district from overseas. But that phase is passing. Cheaper fuel will restore the balance, and it is well to remember that there is an enormous mass of work, held up during the war, still awaiting attention. That demand must sooner or later be met, and there are not a few manufacturers who are convinced that as soon as prices reach an economic level a period of progressive expansion and prosperity will open out.

### Cleveland Iron Trade.

The position in the Cleveland pig iron trade has not undergone much change during the week. The ironmasters are still firm in their determination not to re-start the blast-furnaces until coke, ore, and limestone are cheaper, and the coal and quarry owners declare it is impossible to make further concessions. There were expectations that a few more furnaces would have been lighted up ere now, but these anticipations have not materialised, and at one or two works where tentative arrangements were being made for a resumption, preparations have been held up. Foreign competition in the iron trade is becoming less keen. German makers are apparently so well off for orders that they can give no promise of prompt delivery, and French and Belgian prices are inclined to harden, so that the huge imports of foreign iron are not likely to continue. But there is still a gulf to be bridged between home and foreign prices, and the former are still too high to attract buyers. There is scarcely any No. 3 Cleveland G.M.B. to be got, the only producing firm being well sold; but even so the price has fallen to 125s. per ton, and all the other qualities are at the official minima.

### Hematite Pig Iron.

The drop in the price of East Coast hematite pig iron has tended to improve the home demand somewhat. But in the foreign market it is still difficult to secure orders against foreign competition, and although 135s. will be accepted for mixed numbers for export, as against a home price of 140s., the view is that further cuts will have to be made to attract business.

### Iron-making Materials.

The foreign ore trade is absolutely lifeless, and only an odd cargo is being shipped under old contracts. Best Rubio ore of 50 per cent. quality is nominally at 28s. to 29s. per c.i.f. Good medium furnace coke is about 35s. per ton at the ovens, which is equivalent to about 40s. delivered, and that price, in the view of the ironmasters, is 10s. too high.

### Manufactured Iron and Steel.

The manufactured iron and steel trade is very quiet. Home buyers only order for immediate needs, as further reductions are hoped for, and in order to get orders abroad steel makers have to make drastic reductions on the fixed home prices. There seems to be a slight break in the clouds overhanging the shipbuilding industry. Orders for shipbuilding material are scarce at the moment, but the fact that a few tentative inquiries are being made is regarded as a hopeful sign that the turn of the tide may have been reached, although buyers' and sellers' prices reveal a wide difference.

### The Coal Trade.

The Northern coal situation has undergone no material changes. There is absolutely no improvement in the volume of trade, and the entire industry is passing through a trying time. Every now and then there is a spurt in the inquiries from abroad, and merchants get busy forwarding prices, but in only odd cases is there any practical result. The prices are either turned down as being much too high or there is no response at all, which proves conclusively that foreign buyers still expect prices to fall further. The collieries meanwhile are adhering to their quotations, and in the case of steams are actually closing rather than lower their figures, though as might be expected, prompt trade is a matter of increasing urgency. The trade in gas coals and coking is only limited. The same may also be said of bunkers, which are plentifully offered against a poor demand. The coke market is weakening for furnace and foundry sorts. Beehive is quoted considerably lower, while patent oven is also weaker.

### Brighter Outlook in Shipbuilding Trade.

The outlook in the shipbuilding industry has been made appreciably brighter this week by the fact that Tyne builders have received instructions from the Cunard Shipping Company to proceed with work on three liners, the construction of which was suspended some time ago. The vessels affected are the Laconia at Swan, Hunter and Wigham Richardson's, Wallsend, the Audania at Hawthorn, Leslie and Co.'s yard, Hebburn, and the Anconia at the Walker Naval Yard. During the week-end the Mauretania arrived at the Wallsend shipyard of Swan, Hunter and Wigham Richardson and Co., where she will remain for several months to undergo repairs and overhaul and have oil fuel burning apparatus installed.

### New Tees-side Works.

Good progress is now being made with the new works which are being erected on the north bank of the river Tees at Billingham for Synthetic Ammonia and Nitrates, Limited, which company has been formed under the auspices of Brunner, Mond and Co., chemical manufacturers. The works will be most comprehensive in character, extending over an area of about 850 acres of land with a river frontage of about 1650 lineal feet, and will be used for the manufacture and production of ammonia, nitrates, and various by-products. The company holds the patent rights of the Haber process, together with various other patents taken out by the Ministry of Munitions. The erection of dwelling-houses on a very large scale is also in progress for the accommodation of the workmen and their families. Recreation fields will eventually be laid out for the use of the employees, and on the completion of the works employment will be afforded for several thousands of workmen.

## SCOTLAND.

*(From our own Correspondent.)*

### Continued Inaction.

A WEEK or two ago there seemed grounds for believing that conditions were taking a turn for the better. Here and there works were reopening their doors, and, with fuel becoming considerably cheaper, many others were expected to follow suit. These expectations have not yet been realised, and the reason is apparent to all who wish to recognise it. Steel, coal, and other products have been reduced bit by bit until now quotations are considerably less than they were a month or so ago; but prices are still too high to afford any inducement to buyers. Many orders have been lost, and it is said that in some lines

it is even questionable if much business could be got even if prices were comparable with continental figures. At present some products are being quoted at prices which, in view of oncost charges, would entail considerable loss, but are still too high to secure orders. The consequences of the situation are apparent in the slowing down of production at some of the works which have re-started and the introduction of a system of short time at the majority of the collieries. Markets are almost devoid of interest. Practically nothing is being done in steel, iron and coal. The freight market also is dull and flat. Plenty of tonnage is on offer, but few negotiations reach completion. Here and there ridiculously low prices are hinted at, but, generally speaking, works are merely marking time. A crumb of comfort is derived from the report that for some commodities continental makers are increasing their prices, while deliveries are becoming remote.

**Hope for the Clyde.**

Conditions have assumed a more hopeful aspect in view of the possibility of the receipt of Admiralty orders. Builders have been reported to have been in London in connection with this matter, and developments are hoped for. The lack of new business on the Clyde is reflected in all kindred industries, and much is hoped for from the resumption of naval construction.

**Pig Iron.**

A more hopeful tone pervades the pig iron trade. Some eight furnaces are now in operation for the production of foundry pig iron, and with coke becoming still cheaper other furnaces are expected to resume. The demand is not large at present, but as the output increases a better demand is anticipated. Wages will come under review from time to time, and prices must gradually assume a marketable basis.

**Finished Steel and Iron.**

With regard to the steel industry one can only reiterate what has been said scores of times already. The business in hand is altogether insufficient to provide employment, and new business is almost entirely absent. It is rumoured that one of the steel mills which was re-started some time ago will have to close down. It is said that works across the border can undersell local makers of sectional material at present. Sheets, as well as plates and sections, are extremely slow. In view of the fact that Belgian makers have as much in hand as they can tackle for a long time ahead and that some overseas markets must be very short of supplies, home makers anticipate the placing of some fairly good orders. Steel strip makers are comparatively busy. Malleable bar mills are idle. Orders on hand have almost dried up and new orders at £16 per ton are not to be expected. Some makers say, however, that the business is not to be had, even although their quotations were reduced to competitive levels. The engineering trade is very quiet all round.

**Coal.**

The coal markets remain devoid of orders despite all efforts to meet buyers. Inland sales show little or no movement and the export trade is not a great deal better. The collieries in the Lothians are working fairly well, but in other districts short time is general. Supplies still predominate, and even with prices showing a 50 per cent. reduction in some cases, business is meagre in the extreme. Large coal is neglected and small stuffs receive the bulk of the orders, such as they are. About forty-five steamers are loading at Scottish ports at the time of writing, but the majority are boats of small tonnage. Aggregate shipments during the week amounted to 160,805 tons, against 139,634 in the preceding week and 340,489 tons in the same week in 1913. Two collieries have been closed down for an indefinite period. The miners have lifted their tools and the ponies have been brought to the surface.

## WALES AND ADJOINING COUNTIES.

*(From our own Correspondent.)*

**Trades Union Congress.**

THE Trades Union Congress concluded its deliberations at Cardiff on Saturday, and it was a very noticeable feature of the whole week's proceedings that the delegates were by no means unanimous on many subjects vitally affecting them. Taken on the whole, it cannot be said that Labour has advanced its position to any appreciable extent as the result of its annual gathering. Resolutions galore have, of course, been passed on a variety of subjects from inflation of capital to the conditions of seamen and the necessity for the amendment of the Merchant Shipping Act. A question of considerable interest related to the policy of trade unions in regard to the conduct of industrial disputes, and a resolution was submitted declaring that the results to the workers as a whole from industrial strikes carried out on present lines make it imperative that adequate machinery should be provided through the Trades Union Congress whereby—in the event of any serious industrial dispute being likely to lead to a stoppage of work involving directly or indirectly large bodies of workers—before a stoppage of work takes place a proper opportunity for consultation and for consideration of the merits of the dispute must be provided so that the power and influence of the labour movement may be brought to bear, first, to obtain an equitable settlement without a stoppage, and secondly, failing such a settlement, that the machinery and resources of the movement generally may be co-ordinated and applied in such a way as to ensure a successful issue. The resolution met with very considerable opposition, as it would put an end to the "lightning strike" on the part of any single union, and was defeated on a card vote by 5,628,000 to 981,000.

**Unemployment Problem.**

Unemployed have been adopting the tactics of labour in other parts of the country and have been organising "marches" to the offices of the public authorities at Cardiff, demanding extra relief, and the cry of "Work, not doles" has been raised. The Lord Mayor of Cardiff received a deputation at the end of last week from unemployed who were demonstrating, and a special meeting of the General Purposes Committee of the City Council was held on Monday as a consequence, when the whole question of finding work was discussed. Various suggestions were put forward for providing relief work in the way of effecting local improvements, the widening of roads, &c. Ultimately all the suggestions submitted as affording possible employment were referred to the respective committees of the Council concerned, who were given plenary powers to put in hand all work possible, subject to the approval of the Finance Committee, the total expenditure not to exceed £30,000 without the further approval of the Council. It was also decided to make representations to the Cabinet Committee of the Government that national assistance should be given to local authorities in order that the cost of relief measures may be equally distributed over the country. It is interesting to note that whereas the rates at Cardiff in 1914 were 7s. 11d., they will be at least 16s. 7d. for 1921.

**Ship Repairing Competition.**

Reference has been made on a previous occasion to the relatively high cost of labour and its disastrous effect upon employment in the ship repairing industry of South Wales owing to orders being sent abroad, where the work can be done cheaper. An instance of this state of affairs has just come to light, the case being that of the steamship Ulversmead, of 6600 tons deadweight, which was formerly owned by the Western Counties Shipping Company, Cardiff. This vessel has been undergoing repairs by John Shearman, Limited, at Barry, but was recently sold by auction for £6100 to Spanish buyers. Messrs. Shearman had already carried out work on the ship amounting, it is stated, to a cost of from four to five times the purchase price of the steamer, and in order to complete the contract they submitted to the new owners a tender of about £21,000. The new owners, the Compania Noveira Amaya, of San Sebastian, Spain, have, it is now reported, informed Messrs. Shearman that they are able to get the repairs completed at Bilbao at a much lower cost, notwithstanding the fact that as the main engines of the steamer have been removed, the vessel will have to be towed to Spain. The engines are to be shipped in the main hold and two tugs will take the Ulversmead to Bilbao at a cost of about £1500. In another case a Cardiff-owned steamer was re-classed at Hamburg in a month at a cost of £8000, whereas it is estimated that the work would have taken about seven weeks and cost £50,000 in South Wales.

**Shipping Facilities and Developments.**

Colliery owners are having a far from good time and shipping companies are experiencing a decidedly bad time. Freight rates are well below what they were in pre-war times, and to add to the difficulties of shipowners the homeward markets have fallen flat and the question how and where to run tonnage and avoid a loss on the running is a problem which faces all managers. Their task would to an appreciable extent be minimised if delays in port could be curtailed. Detention is a serious cost, and anything which contributes to the turning round of tonnage more quickly is of great benefit to shipowners and all concerned. For this reason shipowners welcome any improvement in port facilities, and it is gratifying to find that the Cardiff Railway Company is doing its best to put all its dock appliances in order. Quite recently two tips at the Roath basin, Bute Docks, have come into operation after undergoing repair, and at the East Dock the company is constructing three well-equipped coal hoists of 30 tons capacity, each of which will be capable of dealing with 500 to 600 tons of coal per hour. The first of these hoists is expected to be ready in October and the other two a little later. The hoists are 90ft. in height and will be capable of tipping at a height of 60ft., so that large light steamers will be able to take bunkers. The hoists are fitted with hydraulic cranes of 30 cwt. and 6 tons capacity, the latter being provided to facilitate the shipment of coal by the anti-breaking appliance. At Swansea, where the harbour engineer has presented a report to the Harbour Trust Executive concerning the substitution of oil fuel for coal for the working of the hydraulic and electric appliances and does not recommend the change for the present, it is interesting to note that nothing is being left undone to improve the position and trade of the port. The general manager of the Trust has recently issued a circular to shippers and others informing them that the Eastern Conference has arranged to run a regular service of steamers between Swansea and Indian ports, the first sailing being that of the steamship Clan Macbrayne, which takes cargo for Colombo, Madras and Calcutta, for which the closing date has been fixed for Tuesday, the 27th inst. The steamship Malla, which will take cargo for Calcutta only, will follow in October. It is expected that some of the new boats will use oil fuel and will therefore be able to take advantage of the facilities which Swansea provides in this respect, thus saving them considerably in time and cost in bunkering. The first ship to take passengers between Cardiff and New York left the Bute Docks on Thursday of last week, this being the steamship City of Lucknow, which took close on one hundred cabin passengers. It is hoped that a regular passenger service will be arranged. The steamship City of Lucknow, prior to being acquired by the Ellerman line, was the German ship Heluan.

**Current Business.**

The coal market continues in a rather sluggish condition and the inquiry does not show any real expansion. This is not surprising; in fact, it is what was expected, as this month and next are, even under normal conditions, usually quiet, and at the present time consumers abroad are by no means as well placed as traders in this country. The exchanges are still very unfavourable and industry is slower to get going than is the case here, notwithstanding our recent strike troubles. People abroad consequently are not buying anything more than their barest requirements, and they are comparatively meagre. There is no fresh news regarding contracts for coals for shipment over a period of two or more months. Tenders for the 30,000 tons of best steams for the Norwegian State Railways had to be returned on Monday. These coals are for shipment during October-November, but it seems very doubtful whether the business will come to South Wales, which has strong competitors in the North. The last order from the Norwegian State Railways for 8500 tons went to a Newcastle firm for Lambton screened steams, as the price tendered was nearly 7s. 6d. per ton below the price sent in for best Admiralty large from this district. The prices from South Wales will have to be cut down if foreign orders are to be secured, but unfortunately costs of production are relatively much higher here than they are in the North. The tone of the market here for superior coals is very steady. Coalowners are not going to work their pits unless they can get prices which cover their costs, but inferior grades of coals are plentiful and easy in price. At the moment the position of exporters is not altogether an enviable one owing to the risks attaching to c.i.f. business. The situation regarding freight rates is difficult. Shipowners are daily finding that it does not pay to run tonnage at present rates, and reports are current that more tonnage will shortly be laid up than has yet been known. This, combined with scarcity of homeward business, will probably stiffen outward rates, so that exporters are very cautious about quoting ahead owing to the risks involved.

## Latest News from the Provinces.

### SHEFFIELD.

**Iron, Steel, and Fuel Prices.**

Hoops have fallen by 60s., making the official quotation for steel £14 5s. and for iron £17 5s., and bright drawn steel bars are said to have changed hands down to £12, whereas two or three years ago they were well over £40. These are apparently the only changes that have occurred during the week. Very little hematite iron is being bought, though the West Coast price for Bessemer mixed numbers is now down to £7 15s. delivered in this area. There appears to be rather a harder tendency in continental iron and steel. Slacks are said to have been done down to 5s. a ton, but such a price was given probably for very fine stuff. From 8s. to 9s. has covered some recent transactions, but the usual figure seems to be higher than that. Collieries are not over-producing so much now, and an increased demand on industrial account is looked for, while export inquiries are coming in better. Gas fuels are not too brisk.

### WALES AND ADJOINING COUNTIES.

**Swansea Metal Exchange.**

Business all round is quiet, though a little more confidence prevails regarding the future. Prices are on the easy side and business has been done on the basis of 21s. 6d., I.C. 14 × 20, for delivery forward and 23s. for prompt supplies. Interest is displayed concerning the meeting of the South Wales Tin-plate Joint Industrial Council called for the 23rd inst. This meeting has been arranged at the request of the men's side, and the idea prevalent is that they desire to secure a revision of the existing agreement, their opinion being that the cost of living does not justify the reductions in wages that are taking place.

## CATALYSIS.

A GENERAL discussion on "Catalysis, with Special Reference to Newer Theories of Chemical Action," will be held under the auspices of the Faraday Society on Wednesday, September 28th, at the Institution of Electrical Engineers, Victoria Embankment, W.C. 2. The discussion will be divided into two parts. Part 1, beginning at 4.30 p.m., will deal with the radiation theory of chemical action, and will be opened by Professor J. Perrin, of Paris. The second portion of the discussion will concern itself with heterogeneous reactions, and will be opened by Professor Irving Langmuir, Chief Research Chemist to the General Electric Company of America. It is expected that Professor Arrhenius and Professor Victor Henri will also be present, and among others who will contribute to the discussion are Professor E. C. C. Baly, Professor F. G. Donnan, Professor W. C. McC. Lewis, Professor A. Lindemann, Professor A. W. Porter, and Dr. E. K. Rideal. Fellows of the Chemical Society are invited to attend this meeting. Others interested in the subject may obtain tickets of admission from the secretary of the Faraday Society, 10, Essex-street, London, W.C. 2.

## PRODUCTION OF PIG IRON AND STEEL IN AUGUST.

THE production of pig iron in August amounted to 93,600 tons, compared with 10,200 tons in July. The output in March, the month immediately preceding the coal stoppage, was 386,000 tons, and in August of last year 752,400 tons, which was the record monthly total since the war. The production of steel ingots and castings in August amounted to 432,600 tons, compared with 117,200 tons in July, 359,100 tons in March, and 709,200 tons in August, 1920. The number of blast-furnaces in operation at the end of August was 46, as against 15 at the end of July. The number in operation immediately before the coal stoppage was 109, and in August of last year 303. Of the pig iron produced in August 30,200 tons were hematite, 24,400 tons basic, 28,500 tons foundry, 8500 tons forge, and 2000 tons of "other qualities."

# Current Prices for Metals and Fuels.

## IRON ORE.

| | |
|---|---|
| **N.W. Coast—** | |
| Native | — |
| [1] Spanish | 28/- |
| [1] N. African | 28/- |
| **N.E. Coast—** | |
| Native | — |
| Foreign (o.i.f.) | 28/- to 29/- |

## PIG IRON.

| | Home. £ s. d. | Export. £ s. d. |
|---|---|---|
| **Scotland—[2]** | | |
| Hematite | 7 15 0 | — |
| No. 1 Foundry | 8 5 0 | — |
| No. 3 ,, | 8 0 0 | — |
| **N.E. Coast—** | | |
| Hematite Mixed Nos. | 7 0 0 | 6 15 0 |
| No. 1 | 7 2 6 | 7 2 6 |
| Cleveland— | | |
| No. 1 | — | — |
| Silicious Iron | — | — |
| No. 3 G.M.B. | 6 5 0 | 6 5 0 |
| No. 4 Foundry | 5 19 0 | 5 19 0 |
| No. 4 Forge | 5 17 6 | 5 17 6 |
| Mottled | 5 17 6 | 5 17 6 |
| White | 5 15 0 | 5 15 0 |
| **Midlands.** | | |
| Staffs.— | | |
| All-mine (Cold Blast) | 17 0 0 to 17 7 6 | |
| Part Mine Forge | *None offering.* | |
| ,, Foundry No. 3 | ,, | |
| Northampton *(Delivered Midlands).*— | | |
| Foundry Nos. 2 and 1 | *Nominal.* | |
| ,, No. 3 | 6 10 0 | |
| ,, Forge | *Nominal.* | |
| Derbyshire [3] *(All nominal).*— | | |
| No. 3 Foundry | 6 10 0 to 6 15 0 | |
| Forge | 6 0 0 | |
| Lincolnshire— | | |
| Basic | *Uncertain.* | |
| Foundry | ,, | |
| Forge | ,, | |
| **N.W. Coast—[4]** | | |
| N. Lancs. and Cum.— | | |
| Hematite Mixed Nos. | 7 15 0 | |

## MANUFACTURED IRON.

| | Home. £ s. d. | Export. £ s. d. |
|---|---|---|
| **Scotland—** | | |
| Crown Bars | 16 0 0 | — |
| Best ,, | 17 0 0 | — |
| **N.E. Coast—** | | |
| Crown Bars | 16 0 0 | — |
| Best ,, | 17 0 0 | — |
| Tees | 14 10 0 | — |
| **Lancs.—** | | |
| Crown Bars | 16 0 0 | — |
| Hoops | 20 5 0 | 20 0 0 |
| **S. Yorks.—** | | |
| Crown Bars | 16 0 0 | — |
| Best ,, | 17 0 0 | — |
| Hoops | 17 5 0 | — |
| **Midlands—** | | |
| Marked Bars (Staffs.) | 20 0 0 | — |
| Crown Bars | 16 0 0 | — |
| Nut and Bolt Bars | 15 10 0 to 16 0 0 | |
| Black Sheets (dbls. nom.) | 17 0 0 to 17 10 0 | |
| Galv. Sheets, 24 W.G. (f.o.b. L'pool, or equal) | 20 0 0 to 22 0 0 | |
| Gas Tube Strip | 17 10 0 | |

## STEEL.

| | Home.[6] £ s. d. | Export.[7] £ s. d. |
|---|---|---|
| **Scotland—[5]** | | |
| Boiler Plates | 19 0 0 | — |
| Ship Plates ⅜in. and up | 14 0 0 | — |
| Sections | 13 10 0 | — |
| Steel Sheets ⅛in. to ⅜in. | 15 5 0 | — |
| Sheets (Gal. Cor. 24 B.G.) | — | 24 0 0 |

## STEEL (*continued*)

| | Home. £ s. d. | Export. £ s. d. |
|---|---|---|
| **N.E. Coast—** | | |
| Ship Plates | 14 0 0 | 14 0 0 |
| Angles | 13 10 0 | 13 10 0 |
| Boiler Plates | 19 0 0 | 19 0 0 |
| Joists | 13 10 0 | 13 10 0 |
| Heavy Rails | 14 0 0 | — |
| Fish-plates | 19 0 0 | — |
| Channels | 14 10 0 | — |
| Hard Billets | 11 0 0 | — |
| Soft Billets | 9 10 0 | — |
| **N.W. Coast—** | | |
| **Barrow—** | | |
| Heavy Rails | 14 0 0 | — |
| Light ,, | 16 0 0 to 18 0 0 | |
| Billets | 13 0 0 | — |
| Ship Plates | 14 0 0 | — |
| Boiler ,, | 20 0 0 | — |
| **Manchester** *(Prices irregular and uncertain, unchanged)*— | | |
| [8] Bars (Round) | 12 0 0 to 14 0 0 | |
| [8] ,, (others) | 13 0 0 to 15 0 0 | |
| Hoops (Best) | 20 5 0 | 20 0 0 |
| ,, (Soft Steel) | 14 5 0 | 14 0 0 |
| Plates | 14 0 0 | — |
| ,, (Lanca. Boiler) | 20 0 0 | — |
| **Sheffield—** | | |
| Siemens Acid Billets | 16 0 0 | — |
| Bessemer Billets | 15 10 0 | — |
| Hard Basic | 13 0 0 | — |
| Soft ,, | 11 0 0 | — |
| Hoops | 14 5 0 | — |
| Soft Wire Rods | 13 15 0 | — |
| **Midlands—** | | |
| Small Rolled Bars | 11 10 0 to 13 0 0 | |
| Bessemer Billets and Sheet Bars | 7 10 0 to 8 10 0 | |
| [2] Hoops | 14 0 0 | — |
| Tube Strip | 12 0 0 to 13 0 0 | |
| Angles and Joists | 13 10 0 | — |
| Tees | 14 10 0 | — |
| Bridge and Tank Plates | 14 0 0 | — |

## NON-FERROUS METALS.

| | |
|---|---|
| **Swansea—** | |
| Tin-plates, I.C., 20 by 14 | 21/6 to 23/- |
| Block Tin (cash) | 156 12 6 |
| ,, (three months) | 158 15 0 |
| Copper (cash) | 67 17 6 |
| ,, (three months) | 68 17 6 |
| Spanish Lead (cash) | 23 5 0 |
| ,, (three months) | 22 15 0 |
| Spelter (cash) | 25 0 0 |
| ,, (three months) | 25 10 0 |
| **Manchester—** | |
| [9] Copper, Best Selected Ingots | 71 0 0 |
| ,, Electrolytic | 74 10 0 |
| [10] ,, Strong Sheets | 103 0 0 |
| ,, Loco Tubes | 0 1 2½ |
| Brass Loco Tubes | 0 0 11½ |
| ,, Condenser | 0 1 4½ |
| Lead, English | 24 10 0 |
| ,, Foreign | 23 10 0 |

(*Metal prices practically unchanged*).

## FERRO ALLOYS.

(*All prices now nominal*).

| | Per Ton. | Per Unit |
|---|---|---|
| Tungsten Metal Powder | 1/11 per lb. | |
| Ferro Tungsten | 1/6 to 1/8 per lb. | |
| Ferro Chrome, 4 p.c. to 6 p.c. carbon | £36 | 12/- |
| ,, 6 p.c. to 8 p.c. ,, | £34 | 12/- |
| ,, 8 p.c. to 10 p.c. ,, | £34 | 12/- |
| ,, Specially Refined | | |
| Max. 2 p.c. carbon | £79 | 28/- |
| ,, 1 p.c. ,, | £94 | 32/- |
| ,, 0·75 p.c. carbon | £110 | 41/- |
| ,, carbon free | 2/8 per lb. | |
| Metallic Chromium | 5/6 per lb. | |
| Ferro Manganese (per ton) | £18 for home. | |
| ,, Silicon, 45 p.c. to 50 p.c. | £13 10 0 scale 5/- per unit | |
| ,, ,, 75 p.c. | £20 10 0 scale 6/- per unit | |
| ,, Vanadium | 22/- per lb. | |
| ,, Molybdenum | 9/- per lb. | |
| ,, Titanium (carbon free) | 1/6 per lb. | |
| Nickel (per ton) | £190 | |
| Cobalt | 15/- per lb. | |
| Aluminium (per ton) | £110 to £120 (British Official). | |

## FUELS.

| | Export. |
|---|---|
| **SCOTLAND.** | |
| **Lanarkshire—** | |
| (f.o.b. Glasgow)—Steam | 25/- |
| ,, ,, Ell | 26/- |
| ,, ,, Splint | 26/6 to 30/- |
| ,, ,, Trebles | 29/- to 30/- |
| ,, ,, Doubles | 27/6 |
| ,, ,, Singles | 25/- |
| **Ayrshire—** | |
| (f.o.b. Ports)—Steam | 25/- |
| ,, ,, Splint | 26/6 |
| ,, ,, Trebles | 29/- |
| **Fifeshire—** | |
| (f.o.b. Methil or Burntisland)—Steam | 22/- to 26/- |
| Screened Navigation | 32/- |
| Trebles | 28/- |
| Doubles | 26/- |
| Singles | 24/- |
| **Lothians—** | |
| (f.o.b. Leith)—Best Steam | 22/6 |
| Secondary Steam | 21/6 |
| Trebles | 30/- |
| Doubles | 27/- |
| Singles | 25/- |
| **ENGLAND.** | |
| **[11] N.W. Coast—** | |
| Steams | 44/- |
| Household | 58/8 to 60/- |
| Coke | 37/6 to 42/6 |
| **Northumberland—** | |
| Best Steams | 27/6 to 30/- |
| Second Steams | 25/- to 27/- |
| Steam Smalls | 15/- to 17/6 |
| Unscreened | 22/6 to 27/- |
| Household | 30/- to 35/- |
| **Durham—** | |
| Best Gas | 29/- |
| Second | 25/- to 27/6 |
| Household | 30/- to 35/- |
| Foundry Coke | 45/- to 55/- |
| **Sheffield—[12]** | |
| S. Yorks. Best Steam Hards | 33/2 to 33/8 |
| Derbyshire Hards | 32/8 to 33/2 |
| Seconds | 31/8 to 32/2 |
| Cobbles | 31/8 to 32/2 |
| Nuts | 31/2 to 32/2 |
| Washed Smalls | 28/8 to 30/2 |
| Best Hard Slacks | 20/- to 25/- |
| Seconds ,, | 20/- to 23/- |
| Soft Nutty | 20/- to 25/- |
| Pea | 18/- to 22/- |
| Small ,, | 15/- to 18/- |
| House, Branch | 37/2 to 37/8 |
| ,, Best Silkstone | 33/8 to 34/2 |
| Blast Furnace Coke | 30/- |
| **SOUTH WALES.** | |
| **Cardiff—** | |
| Steam Coals: | |
| Best Smokeless Large | 32/6 to 34/- |
| Second ,, ,, | 32/- to 32/6 |
| Best Dry Large | 30/- to 31/- |
| Ordinary Dry Large | 27/6 to 30/- |
| Best Black Vein Large | 29/- to 30/- |
| Western Valley ,, | 27/6 to 28/6 |
| Best Eastern Valley Large | 27/6 to 28/6 |
| Ordinary ,, ,, | 25/- to 27/- |
| Best Steam Smalls | 19/- to 19/6 |
| Ordinary ,, | 10/- to 17/- |
| Washed Nuts | 32/6 to 35/- |
| No. 3 Rhondda Large | 30/- to 35/- |
| ,, ,, Smalls | 22/6 to 25/- |
| No. 2 ,, Large | 27/6 to 30/- |
| ,, ,, Through | 20/- to 24/- |
| ,, ,, Smalls | 16/- to 17/- |
| Coke (export) | 60/- to 62/6 |
| Patent Fuel | 30/- to 32/6 |
| Pitwood (ex ship) | 30/- to 32/6 |
| **Swansea—** | |
| Anthracite Coals: | |
| Best Large | 52/6 to 55/ |
| Seconds | 50/- to 52/6 |
| Red Vein | 40/- to 45/- |
| Big Vein | 52/6 to 55/- |
| Machine-made Cobbles | 70/- to 72/6 |
| Nuts | 72/6 to 75/- |
| Beans | 60/- to 62/6 |
| Peas | 40/- to 42/6 |
| Breaker Duff | 12/6 to 15/- |
| Rubbly Culm | 18/- to 20/- |
| Steam Coals: | |
| Large | 32/6 to 35/- |
| Seconds | 30/- to 32/6 |
| Smalls | 15/- to 17/6 |
| Cargo Through | 22/6 to 25/- |

[1] Delivered. [2] Net Makers' works. [3] At furnaces. [4] Delivered Sheffield. [5] Glasgow, Lanarkshire and Ayrshire. [6] Home Prices—All delivered Glasgow Station.
[7] Export Prices—F.O.B. Glasgow. [8] Prices represent the real market before the *official* change was made. [9] These prices are practically alike now.
[10] Sheets reduced while other prices are advancing. [11] Except where otherwise indicated coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export.
[12] For inland sales. [13] Per ton f.o.b.

# French Engineering Notes.

*(From our Correspondent in Paris.)*

**Tariff Revision.**

THE strong protests being made by some of the Chambers of Commerce, and particularly by the silk industry in the Lyons district, have led the Minister of Commerce to suggest that there may be a revision of the present rates of import duties at an early date. It is argued that the Government fiscal policy regarding foreign trade has been carried out in the interests of certain groups and not in the interest of trade and industry as a whole, the result being that nine countries have retaliated against the higher French duties, and that no single country has consented to adopt a "commercial arrangement" for fear that such arrangements with other countries might place it at a disadvantage. The whole system of putting up duties on imports as a means of compelling foreign countries to make concessions in favour of French goods has failed. The immediate result has been the shutting out of French merchandise from foreign markets, and although the Anti-dumping Bill has not yet been applied in its entirety it is felt to be a perpetual menace to French trade. While the imports of manufactured goods as a whole have been restricted by the high duties, there has nevertheless been an increase in the purchases of certain products, such as locomotives and electrical machinery, steel springs and iron castings, and if home consumers are prepared to pay more for such goods, it cannot be said that the import duties have done much for the protection of home industries. There are cases where the best must be had, and if home manufacturers cannot produce what is needed, they will not get much assistance from what was intended to be a practically prohibitive tariff. Nor has the apparently prohibitive tariff against Germany stopped the importation of German goods. There are far more German products sold now than at any time since the war. The Government fiscal policy has failed in every one of its aims. As other countries are simply retaliating and are refusing to enter into separate commercial arrangements, it is suggested that the Government will be obliged to return to the old system of treaties of commerce, and before that can be done there must be a reduction of the import duties to permit of a freer interchange of goods. It appears that a revision of the rates is now under consideration.

**Mont Cenis Commemoration.**

A series of fetes is being organised to commemorate the inauguration of the Mont Cenis tunnel fifty years ago. Excursions will be made to Annecy and other places associated with the Savoy engineer, Germain Sommeiller, whose invention of the perforator suggested to him the possibility of driving the tunnel. Germain Sommeiller was educated at Annecy, and obtained his diploma at Turin, and with the aid of Cavour was able to secure the interest of King Victor Emmanuel, who, on August 30th, 1857, fired the first explosive charge which started what was then considered a particularly daring enterprise. Sommeiller's perforating machines were put in operation on the Italian side in 1861, and two years later on the Savoy side, the tunnel being completed on September 24th, 1870. It was not, however, inaugurated until September 17th, 1871, and on account of the French military disaster there was nothing in the nature of a celebration. It is intended, therefore, to give particular importance to the fêtes being organised this month. On account of the gradients, transit through the Mont Cenis tunnel has always been slow and irksome, but the electrification of the line, which has been completed on the Italian side, and will be undertaken shortly on the French section, will greatly facilitate the service.

**Paris Water Supply.**

The extraordinary drought this year has had a serious effect upon the supply of water in Paris, which has had to be supplemented by a much greater quantity of sterilised water. The normal supply of 100,000 cubic metres from the Avre has been reduced to 25,000 cubic metres, and in view of the deficiency of spring water, the Paris Municipal Council is hastening investigation into other sources, and is sending a commission to the Vals de Loire, where pumping operations have been carried on during the past year to ascertain if there is likely to be any diminution in the level of subterranean water. The local authorities are strongly opposed to the underground supplies being tapped for distribution to Paris, as they argue that the effect must be prejudicial to local interests. If it be found that the underground level remains practically constant the objections cannot be sustained, and Paris will be able to draw supplies of excellent water that will obviate all risks of shortage in the future.

**Strikes.**

The dispute between the textile workers and employers in the Nord over the reduction in wages is still without a solution. Having failed to come to terms at a conference held during the week, the men's union has arranged with the unions in other industries to declare a general strike. The movement is limited for the time being to Roubaix and Tourcoing, where the operatives hope to force the employers' hands by arresting the industrial activity in that important district. It is regarded as very doubtful whether the strike will have any appreciable effect, for a large section of the operatives is convinced that a reduction in wages is inevitable, and several factories have been re-opened at the request of the men who have returned to work. The situation is regarded by the employers as being much more hopeful.

**New Floating Dock.**

A floating dock has been recently completed at Rouen for raising vessels with a displacement of 4200 tons. Its length is 110 m. It has two large cranes, two powerful pumps, a fire-engine, and the usual electrical equipment, the energy being supplied to a transformer at the dock side at 5500 volts and delivered to the floating dock by cables. Its first operation last week was the raising, under difficult conditions, of a 3500-ton steamer, which was satisfactorily accomplished in three hours.

# British Patent Specifications.

*When an invention is communicated from abroad the name and address of the communicator are printed in italics.*

*When an abridgment is not illustrated the Specification is without drawings.*

*Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.*

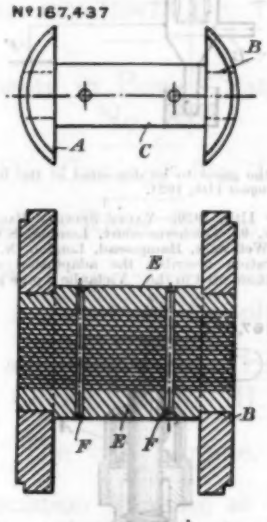
*The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.*

## INTERNAL COMBUSTION ENGINES.

167,437. February 25th, 1921.—IMPROVEMENTS IN OR RELATING TO MAGNETOS, Société Dorten Doublet et Cie., of 56, Rue des Arts, Levallois, France.

This invention relates to magneto armatures, and the object is to construct a very strong armature, the core being the only riveted part. The end pieces A are made of steel or cast iron, and have the usual opening B adapted to receive the ends of

N° 167,437



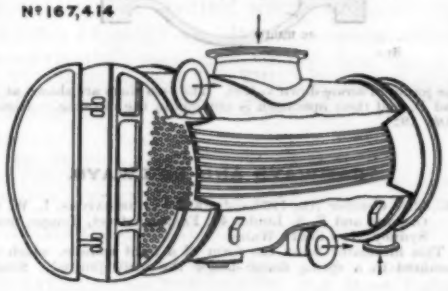

the laminated core C, composed of soft iron laminations packed between two clamping end plates E made of steel and secured by rivets F. The ends of the core are forced fit in the openings B and shoulders butt against the end pieces.—*August 11th*, 1921.

## CONDENSERS AND FEED-WATER HEATERS.

167,414. September 30th, 1920.—SURFACE CONDENSERS, *E. C. R. Marks*, 57, *Lincoln's Inn-fields, London, W.C.* 2.

With the object of preventing the water from draining out of the tubes of surface condensers, when the doors are taken off,

N° 167,414



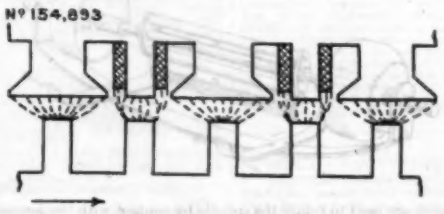
the tubes are bent as shown in the illustration. It is claimed that if the scale on the tubes is not dried by exposure to the atmosphere, it is more easily removed.—*August 11th*, 1921.

## DYNAMOS AND MOTORS.

154,893. November 28th, 1919.—HOMOPOLAR INDUCTION ALTERNATOR, Maschinenfabrik Oerlikon, of Oerlikon, near Zürich, Switzerland.

In homopolar inductor electrical generators it is necessary in order to obtain the largest possible alteration in the magnetic flux for the coils, to keep the stray flux from the rotor as small as possible, as the action of this stray flux lowers the voltage. The reduction of the stray flux is especially desirable in the case

N° 154,893

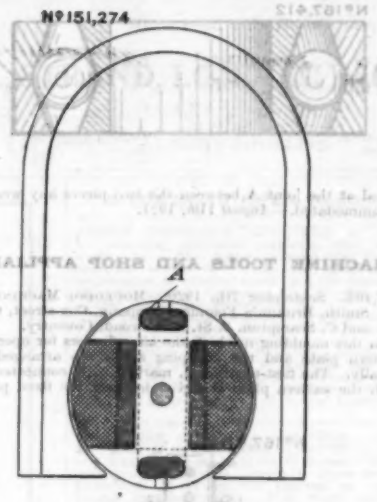


of machines with a small pole pitch, because it is not possible to diminish the air space between the rotor and stator in proportion to the pitch. This invention aims at reducing the stray flux in a simple manner, and involves enlarging the heads of the intermediate teeth between the stator teeth carrying the winding in the manner shown. The cross section of the intermediate teeth is also enlarged.—*August 11th*, 1921.

151,274. September 6th, 1919.—AN IMPROVED ELECTRIC CURRENT GENERATOR FOR HIGH-VOLTAGE IGNITION AND LIGHTING, Jost Gehrig, of No. 35, Broitenrainstrasse, Berne, Switzerland.

This specification describes a generator for the simultaneous supply of high-voltage current for ignition purposes and a low voltage current for lighting, &c. The axis of the winding A for the generators of low-voltage current is at right angles to the

N° 151,274



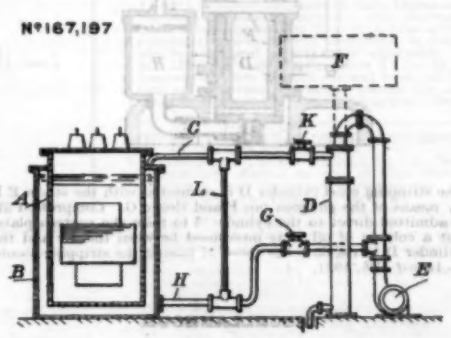

axis of the ignition windings, so that they are not in any way electro-magnetically interlinked with one another.—*August 11th*, 1921.

## TRANSFORMERS.

167,197. April 22nd, 1920.—IMPROVEMENTS RELATING TO THE COOLING OF TRANSFORMERS OR OTHER ELECTRIC APPARATUS, Henry Ambrose Carney, of Antrolins Hall, Mobberley, Chester, and Harold Morgan Lacey, of 221, Harrow-road, Paddington.

The transformer is placed in a tank A containing oil, and water nearly fills the surrounding casing B, the vapour arising from the water being led through a pipe C to a condenser D, where it is liquefied by water forced into the condenser by a pump E or

N° 167,197



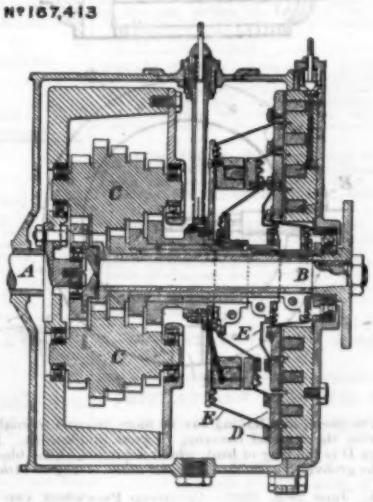

admitted from a tank F. Water to make up for the loss arising from evaporation is supplied through a valve G from the pump E, and enters the transformer casing by way of the pipe H. A valve K controls the admission of the vapour to the condenser. The pipe L serves as a gauge to indicate the water level in the casing.—*July 22nd*, 1921.

## TRANSMISSION OF POWER.

167,413. September 30th, 1920.—CHANGE-SPEED GEARS, J. Cotal, 52, Rue Rouget de l'Isle, Puteaux, France.

In this change-speed gear all the wheels are always in mesh. A is the driving shaft and B the driven shaft. The fly-wheel on A carries a set of planet wheels C C, which mesh with a pinion on the driven shaft and with a series of other pinions on

N° 167,413

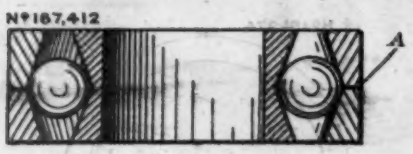



sleeves surrounding the shaft. Any one of these sleeves can be held stationary by means of the electro-magnets D D, which are connected with their respective sleeves by means of resilient plates E E. The ratio of the gear in operation is, of course, dependent upon which of the electro-magnets is energised.—*August 11th*, 1921.

167,412. November 5th, 1920.—BALL BEARINGS, H. Holloway, 43, Dolobran-road, Sparkbrook, Birmingham.

For the purpose of taking up the wear on the races of ball

bearings, the inventor proposes to make one of the races in two pieces with angular working faces. By grinding away the

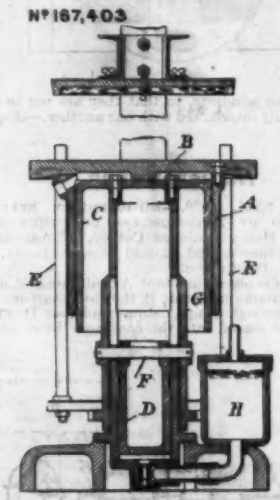



metal at the joint A between the two pieces any wear can be accommodated.—*August 11th*, 1921.

### MACHINE TOOLS AND SHOP APPLIANCES.

167,403. September 7th, 1920.—MOULDING MACHINES, A. P. Smith, Britannia Foundry Company, Cox-street, Coventry, and C. Scampton, 8, St. Ann's-road, Coventry.

In this moulding machine the air cylinders for operating the pattern plate and the stripping stools are arranged concentrically. The first-mentioned, marked A, is connected directly with the pattern plate B and slides over the fixed plunger C.

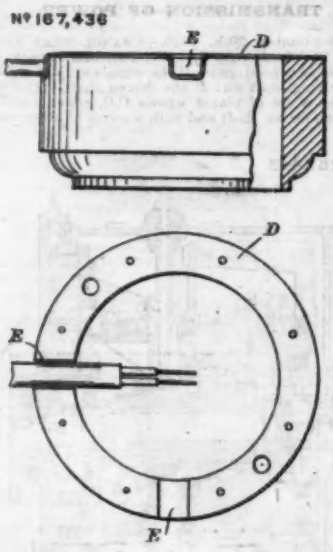



The stripping stool cylinder D is connected with the stools E E by means of the gudgeon pin F and sleeve G. Compressed air is admitted direct to the cylinder A to raise the pattern plate, but a column of oil H is interposed between the air and the cylinder D to regulate the speed of raising the stripping stools. —*August 11th*, 1921.

### MISCELLANEOUS.

167,437. January 18th, 1921.—IMPROVEMENTS IN RELATING TO BONDING BLOCKS FOR METAL-COVERED ELECTRIC WIRING, Alan Kirk and Robert Cecil Milliken, both of 14, Victoria-street, S.W. 1.

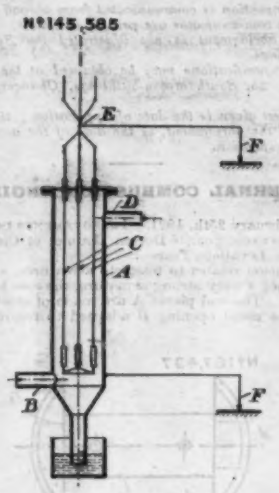
This invention relates to bonding blocks for lead or other metal-covered wiring, and the blocks can be universally used for switches, ceiling roses, &c. The blocks may be composed of wood, metal or other material having a ring or plate of lead




secured to them, and having two or more grooves to enable the wires with their metal covering to pass underneath. In the drawings D is the ring of lead, which is pinned to the block and E are the grooves for the lead-covered wires.—*August 11th*, 1921.

145,585. June 29th, 1920.—IMPROVED PROCESSES AND APPARATUS FOR ELECTRICALLY SEPARATING DUST FROM GASES AND VAPOURS, Dr. Wilhelm North, of Schillerstrasse 32, Hanover, Germany.

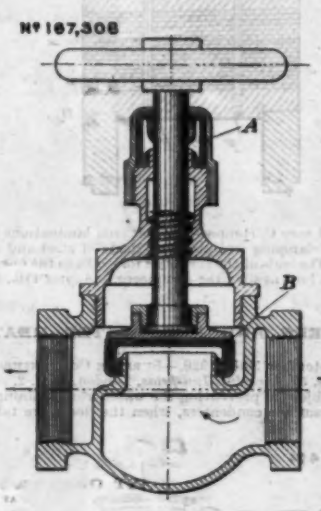
A is the separator casing which may be composed of iron. The gases to be purified enter through the pipe B and pass upwards in the casing. The electrical separating body consists of wires C set in insulators. The casing is funnel-shaped at the bottom to receive the precipitated particles such as tar. The ascending gas comes into contact with the wires C and pass away through the pipe D. The high-tension transformer E is earthed at F, and the iron casing A is also earthed. During operation, current is supplied to the transformer, and a rotary field is produced which imparts a rotary movement to the gases, with the result that the collisions and the centrifugal force cause the matter




suspended in the gases to be deposited at the bottom of the apparatus.—*August 11th*, 1921.

167,306. May 11th, 1920.—VALVE SPINDLE PACKINGS, H. S. Hele-Shaw, 92, Colebrooke-court, London, S.W. 5, and E. Tribe, 8, Well-walk, Hampstead, London, N.W. 3.

The specification describes the adaptation of leak-proof rings, such as those used in the "Victaulic" pipe joint, to make

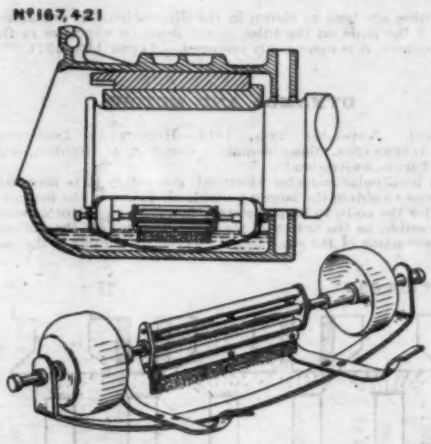



the joints in screw-down valves. The two rings are shown at A and B, and their operation is obvious in the drawing.—*August 11th*, 1921.

### TRAMWAYS AND RAILWAYS.

167,421. October 7th, 1920.—JOURNAL LUBRICATORS, L. W. S. Graham and F. S. Lindo, 40, Fanning-street, Tempe, near Sydney, New South Wales.

This lubricator takes the form of a light spindle, which is mounted in a spring frame below the main journal. Small




wheels are used to rotate the spindle by contact with the journal. Loose flyers hinged to the spindle dip into the oil in the axle box and throw it on to the journal.—*August 11th*, 1921.

## LAUNCHES AND TRIAL TRIPS.

STONEBOAT, motor coaster; built by J. Samuel White and Co., Limited, to the order of the Road Maintenance and Stone Supply Company, Limited; dimensions, 120ft. by 21ft. by 11ft. 3in.; to carry 350 tons deadweight. Engines, Vickers-Petter semi-Diesel motor of 220 brake horse-power at 275 revolutions; delivered, Tuesday, September 6th.

## Forthcoming Engagements.

WEDNESDAY, SEPTEMBER 7TH, TO WEDNESDAY, SEPTEMBER 28TH.

THE SHIPPING, ENGINEERING AND MACHINERY EXHIBITION.—Olympia.

WEDNESDAY, THURSDAY, AND FRIDAY, SEPTEMBER 14TH, 15TH, AND 16TH.

INSTITUTION OF MINING ENGINEERS.—Town Hall, Stoke-on-Trent. For programme see page 230. 11 a.m.

THURSDAY TO TUESDAY, SEPTEMBER 15TH TO 20TH.

INDUSTRIAL WELFARE SOCIETY.—Balliol College, Oxford. For programme see below.

SATURDAY, SEPTEMBER 17TH.

THE INSTITUTION OF PRODUCTION ENGINEERS.—Institution of Mechanical Engineers, Storey's Gate, S.W. "The Manufacture of Ball and Roller Bearings," by Mr. J. D. Scaife. 7 p.m.

WEDNESDAY, THURSDAY AND FRIDAY, SEPTEMBER 21ST, 22ND, AND 23RD.

THE INSTITUTE OF METALS.—Autumn meeting in Birmingham. For programme see page 151.

THURSDAY, SEPTEMBER 29TH.

ASSOCIATION OF RAILWAY COMPANIES' SIGNAL SUPERINTENDENTS AND SIGNAL ENGINEERS.—The Railway Clearing House, London. Sixty-third conference.

SATURDAY, OCTOBER 8TH.

ASSOCIATION OF ENGINEERS-IN-CHARGE.—Holborn Restaurant, London. Twenty-first annual dinner. 6 p.m.

MONDAY, OCTOBER 10TH.

INSTITUTE OF TRANSPORT.—Victoria Hall, Hotel Cecil, London, W.C. 2. Second Institute Dinner. 7.30 p.m.

TUESDAY AND WEDNESDAY, OCTOBER 11TH AND 12TH.

INSTITUTION OF GAS ENGINEERS.—Central Hall, Westminster. Annual meeting.

## PERSONAL AND BUSINESS ANNOUNCEMENTS.

MR. JOHN E. DORMAN, late director of W. H. Dorman and Co., Limited, of Stafford, has severed his connection with that firm and has joined the board of Henry Meadows, Limited, Fallings Park, Wolverhampton, makers of gear-boxes and other automobile components.

CONTRACTS.—Wm. Johnson and Sons (Leeds), Limited, have received a contract for the supply of a complete plant of machinery for the manufacture of retorts, condensers, &c., in connection with a new spelter works which is being installed by a continental firm in Indo-China. The plant consists of grinding, screening, measuring, mixing, and pugging machinery for the various kinds of refractory clays, chamotte, &c., and a hydraulic press with its pump, accumulator and accessories for the production of the retorts. There was, Messrs. Johnson inform us, keen competition on the part of German firms which were anxious to retain such work in their own hands. The receipt of this order by Messrs. Johnson is all the more pleasing to them, as they have just heard that an Australian order has been placed for certain machinery with a German firm, which machinery could, Messrs. Johnson claim, very well have been manufactured by a British firm. This particular order will involve the revision of the Australian laws with reference to the importation of German machinery, as at present such imports are prohibited.

THE INDUSTRIAL WELFARE SOCIETY.—A lecture conference for welfare supervisors will be held at Balliol College, Oxford, on September 15th to 20th. Programme:—Thursday, 15th, 8 p.m., opening address by Lord Gorell. Friday, 16th, 10.30 a.m., lecture, "Industrial Psychology," by Mr. Eric Farmer; 4.30 p.m., lecture, "Economic History," by Mr. C. Delisle Burns; 8 p.m., short talks, "Camping," by Mr. R. Stanford Wood; "The Uses of Debate," by Mr. F. S. Button. Saturday, 17th, 10.30 a.m., lecture, "Educational Possibilities," by Dr. C. W. Kimmins; 8 p.m., lecture, "English Folk Dances and Folk Music," by Mr. Cecil J. Sharp. Sunday, 18th, 10 a.m., short service; 11 a.m., address, "Welfare at the Cross Roads," by Rev. Robert R. Hyde; 8 p.m., lecture, "The Attitude of Labour," by Mr. Fred Bramley. Monday, 19th, 10.30 a.m., lecture, "The Employer's Part," by Sir Andrew R. Duncan; 4.30 p.m., lecture, "The Health of the Industrial Worker," by Dr. E. L. Collis; 8 p.m., open discussion. Each lecture will occupy forty-five minutes and, after a short interval, be followed by one hour's discussion.

FOUNDRY EXHIBITION AT BIRMINGHAM.—In connection with the annual convention next June of the Institution of British Foundrymen, it is proposed to hold an international exhibition of foundry plant and materials during the convention week at Birmingham. The exhibition will be open from June 18th to 24th, and will comprise exhibits from Britain, America, France and Belgium, and embrace every phase of foundry work. It is the first exhibition of such a nature held in this country, and a large influential council has been appointed to make it a success. The organisation of the exhibition is in the hands of the Birmingham Chamber of Commerce. Invitations to attend the conference have been sent to the American Association of Foundrymen, and papers will be contributed from that association as well as from the French and Belgian foundry associations. The exhibition will include plant and materials used in connection with the ferrous and non-ferrous foundry trades. It will be held in the Bingley Hall, which is well adapted for such purposes, and in which every convenience will be provided for exhibiting plant in motion.

FINSBURY TECHNICAL COLLEGE OLD STUDENTS' ASSOCIATION.—The annual general meeting of the above-named association was held at Finsbury Technical College, on September 5th, the President, Professor G. T. Morgan, O.B.E., D.Sc., F.R.S., being in the chair. A report was read of the progress made since the Association was resuscitated in the early part of 1920. The fact that the college is being kept open, an outcome due in no small measure to the individual and collective efforts of old students of the college, should impress on all old students the necessity for the existence of the association. The annual dinner this year has been arranged for Saturday, November 12th, and the smoking concert for Friday, January 27th, both these functions being held at the newly opened Engineers' Club. The first number of a *Bulletin* which it is proposed to issue quarterly is in course of preparation, and all old students are requested to forward immediately an account of what they are now doing for inclusion in it. Application forms for membership and all particulars of the association may be obtained from the hon. secretary, Mr. H. P. Guy, 209, Northumberland-park, Tottenham, N. 17.